Aurora NE Series

Multi Wavelength Nephelometers

User Manual

Version: 1.2

Acoem Australasia
1492 Ferntree Gully Road Knoxfield VIC 3180
Melbourne Australia +61 3 9730 7800 info.au@acoem.com **ecotech.com**

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Manufacturer's Statement

Thank you for selecting the Acoem Australasia Aurora NE Series Multi Wavelength Nephelometers.

The Aurora NE series is the next generation of Acoem Australasia designed and manufactured nephelometers. The Aurora NE Series will perform Multi Wavelength Nephelometers measurements over a range of 0 - 20,000 Mm^{-1} with a low detection limit.

This User Manual provides a complete product description including operating instructions, calibration and maintenance requirements for the Aurora NE Series Multi Wavelength Nephelometers.

Reference should also be made to the relevant local standards which should be used in conjunction with this manual. Some of these standards are listed in this manual.

If, after reading this manual you have any questions or you are still unsure or unclear on any part of the Aurora NE Series, please do not hesitate to contact Acoem Australasia or your local Acoem Australasia distributor.

Please help the environment and recycle the pages of this manual when you have finished using it.

Notice

The information contained in this manual is subject to change without notice. Acoem Australasia reserves the right to make changes to equipment construction, design, specifications and/or procedures without notification.

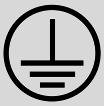
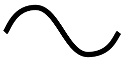
Ecotech Pty. Ltd. has changed its trading name to Acoem Australasia.

Safety Information

Read all the safety information in this section prior to using the equipment. To reduce the risk of personal injury caused by potential hazards, follow all safety notices and warnings in this documentation.

The following internationally recognised symbols are used on Acoem Australasia equipment:

Table 1 – Internationally Recognised Symbols

	Protective conductor terminal	IEC 60417-5019
	Alternating current	IEC 60417-5032
	Caution, hot surface	IEC 60417-5041
	Caution, risk of danger to user and/or equipment Refer to any accompanying documents	ISO 7000-0434
	Caution, risk of electric shock	ISO 3864-5036

These symbols will also be found throughout this manual to indicate relevant safety messages.

Note: Notes are used throughout this manual to indicate additional information regarding a particular part or process.

If the equipment is used for purposes not specified by Acoem Australasia, the protection provided by this equipment may be impaired.

Important Safety Messages

Disconnect Power Prior to Service

Hazardous voltages exist within the instrument. Do not remove or modify any of the internal components or electrical connections whilst the mains power is ON.

Always unplug the equipment prior to removing or replacing any components.

Replacing Parts

Replacement of any part should only be carried out by qualified personnel, using only parts specified by Acoem Australasia, as these parts meet stringent Acoem Australasia quality.

Mains Supply Cord

Do not replace the detachable mains supply cord with an inadequately rated cord. Any mains supply cord that is used with the instrument must comply with the safety requirements (250 V/10 A minimum requirement). A mains power cord with a protective earth conductor must be used.

Ensure that the mains supply cord is maintained in a safe working condition.

Do Not Expose Equipment to Flammable Gases

This equipment is not intended for use in explosive environments, or conditions where flammable gases are present. The user should not expose the equipment to these conditions. Do not introduce any flammable gases into the instrument, otherwise serious accidents such as explosion or fire may result.

Electromagnetic Compliance

The instrument lid should be closed when in normal operation, to comply with EMC regulations.

Means of Lifting/Carrying Instrument

This instrument is a heavy and bulky object. Two persons should lift/carry the object, otherwise use proper lifting equipment. Proper lifting techniques should be used when moving the instrument.

Internal Components

Do not insert a rod or finger into the cooling fans, otherwise injury may result.

Do not energise the instrument until all conductive cleaning liquids, used on internal components, are dried up.

Warranty

This product has been manufactured in an ISO 9001 facility with care and attention to quality.

The product is subject to a 24-month warranty on parts and labour from the date of shipment. The warranty period commences when the product is shipped from the factory. Lamps, filters and other consumable items are not covered by this warranty.

Each instrument is subjected to a vigorous testing procedure prior to despatch and will be accompanied with a parameter list and a multipoint precision check, thereby enabling the instrument to be installed and ready for use without any further testing.

Service & Repairs

Our qualified and experienced technicians are available to provide fast and friendly service between the hours of 8:30 am - 5:00 pm AEST Monday to Friday. Please contact either your local distributor or Acoem Australasia regarding any questions you have about your instrument.

Service Guidelines

This manual is designed to provide the necessary information for the setup, operation, testing, maintenance and troubleshooting of your instrument.

Should you still require support after consulting the documentation, we encourage you to contact your local distributor for support.

To contact Acoem Australasia directly, please e-mail our Technical Support Specialist group at support@ecotech.com or to speak with someone directly:

Please dial 1300 364 946 if calling from within Australia.

Please dial +61 3 9730 7800 if calling from outside of Australia.

Please contact Acoem Australasia and obtain a Return Material Authorisation (RMA) number before sending any equipment back to the factory. This allows us to track and schedule service work and to expedite customer service. Please include this RMA number when you return the equipment, preferably both inside and outside the shipping packaging. This will ensure you receive prompt service.

When shipping instrumentation, please also include the following information:

- Name and phone number
- Company name
- Shipping address
- Quantity of items being returned
- Model number/s or a description of each item
- Serial number/s of each item (if applicable)
- A description of the problem and any fault-finding completed
- Original sales order or invoice number related to the equipment

Shipping Address:

Attention Service Department

Acoem Australasia

1492 Ferntree Gully Road,

Knoxfield, VIC Australia 3180

Product Compliance and Approvals

The Aurora NE Series Multi Wavelength Nephelometers, as manufactured by Acoem Australasia, complies with the essential requirements of the directives listed below (including CE compliance). The respective standards have been applied:

Low Voltage Directive (LVD) Directive 2014/35/EU

EN 61010-1:2010	Safety requirements for electrical equipment, for measurement, control and laboratory use - General requirements

Electromagnetic Compatibility (EMC) Directive 2014/30/EU

EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use - EMC requirements - General requirements

Radio Equipment Directive (RED) 2014/53/EU

EN 300 328 V2.1.1	Wideband transmission systems - Data transmission equipment operating in the 2.4 GHz ISM band and using wide band modulation techniques

Regulatory Compliance Mark (RCM) - Australia

AS/NZS 4268:2017	Radio equipment and systems - Short range devices - Limits and methods of measurement
ARPANSA **Radiation Protection Standard**	Maximum Exposure Levels to Radiofrequency Fields - 3 kHz to 300 GHz - Radiation Protection Series Publication No. 3: 2002

This integrating Nephelometer is also certified to a number of measurement standards - refer to Section 1.2.6.

Manual Revision History

Manual PN: M010068

Current revision: 1.2

Date released: 15 December 2022

Description: User Manual for the Aurora NE Series Multi Wavelength Nephelometers

This manual is the full user manual for the Aurora NE Series Multi Wavelength Nephelometers. This manual contains all relevant information on theory, specifications, installation, operation, maintenance and calibration. Any information that cannot be found within this manual can be obtained by contacting Acoem Australasia.

This manual uses cross reference links extensively throughout this manual. The hot keys below will greatly reduce the amount of time scrolling between references:

- You can access the links by pressing the following:
  - > CTRL + LEFT MOUSE CLICK: Move to the link location
- You can switch between links by pressing the following:
  - > ALT + LEFT ARROW KEY: Returns you to the previous Link
  - > ALT + RIGHT ARROW KEY: Swaps back

Table 2 – Manual Revision History

Edition	Date	Summary
1.1	August 2022	Initial Release for Certification
1.2	December 2022	Public Release

1. Introduction

1.1 Description

The Aurora NE Series Multi Wavelength Nephelometers will measure, continuously and in real-time, light scattering in a sample of ambient air due to the presence of particulate matter (specifically, the scattering coefficient σ_{sp}) at three wavelengths (450 blue, 525 green and 635 red).

The polar nephelometer is unique in that it has a backscatter shutter that can be set to any angle between 10° through to 90° at up to 20 different positions. When the backscatter shutter is positioned at a specific angle the nephelometer measures the light scattering from that angle, through to 170°. Each measurement cycle also includes a measurement without the backscatter active or a 0° angle measurement.

Example:
A scattering angle set to 20° will measure all the scattering from 20° to 170°, a scattering angle at 30° will measure all the scattering from 30° to 170°. The difference between these two angles gives the light scattering for the polar segment of 20° - 30°.

Zero/span calibrations and precision checks are fully automatic once initiated by the user. Different intervals and times can be selected using several types of calibration gases. Calibrations are controlled using a system of internal valves and filters along with the internal sample pump and accurate flow control to either standard or volumetric flow. Temperature pressure and humidity are monitored in real time to provide accurate measurements. The internal ball valves allow zero and span calibrations without interrupting or contaminating the flow at the sample manifold.

All options and configurations are available from an easy-to-use menu system on the 7” colour touch screen display. Data can be collected through multiple formats for ease of analysis.

This section will describe the specifications of the instrument as well as the main components and techniques used to obtain accurate scattering measurements.

1.2 Specifications

1.2.1 Measurement

Range

0 - 20,000 Mm^{-1}

Truncation Angle

7.3° - 172.7°

Wavelengths

450 nm, 525 nm, 635 nm simultaneously

Selectable Angles

Up to 20 angles ranging from 0° - 90° with minimum 1° increments

Zero Noise

635 nm (0°) - 0.05* Mm^{-1}

525 nm (0°) - 0.05* Mm^{-1}

450 nm (0°) - 0.05* Mm^{-1}

635 nm (90°) - 0.05* Mm^{-1}

525 nm (90°) - 0.05* Mm^{-1}

450 nm (90°) - 0.05* Mm^{-1}

* Standard Deviation of 60 second averaging over 200 samples. Kalman Filter enabled.

Sample Flow Rate

2 - 9 slpm using internal pump and flow control

2 - 17 slpm using optional MFC and external pump

1.2.2 Power Requirements

Operating Voltage

100 - 240 VAC (± 10%)

50 - 60 Hz (autoranging)

Overvoltage Category II

24 VDC for non mains operation

Power Consumption

120 VA max (typical at start up) 80 VA after warm (NE-300 and NE-400 standard configuration)

100 VA max (typical at start) 60 VA after warm (NE-100 standard configuration)

* Standard configuration is sample heater off and flow set to 5 lpm.

1.2.3 Operating Conditions

Ambient Temperature:	-20 - 45 °C (-4 - 113 °F)
Relative Humidity:	10 - 95% (non-condensing)
Pollution Degree:	2 (for indoor operation)
Maximum Altitude[1]:	2000 m above sea level

* Not intended for outdoor use.

[1] For higher altitude contact Acoem Australasia for support/assistance.

1.2.4 Communications

Bi-Directional

- RS232 port #1: Normal digital communication.
- RS232 port #2: Multidrop port used for multiple instrument connections on a single RS232.
- USB port: Type B connection.
- TCP/IP: Normal digital communication.
- Bluetooth: Normal digital communication.

Analog Output

Six menu selectable 16 Bit analog voltage outputs: (0 - 5 VDC).

Analog Input

Four menu selectable 16 Bit analog voltage inputs (0 - 5 VDC) CAT I rated.

Digital Output

Four menu selectable digital outputs: Open drain max 500 mA each @ 12 VDC (max total output 2 A).

Digital Input

Four menu selectable digital inputs (0 - 5 VDC) CAT I rated.

Data Storage

- USB memory stick (Optional, Internal, Removable) for data logging, event logging, calibration and configuration storage. For Firmware updating also.
- Micro SD Card 16 GB (External, Removable) for data logging, event logging, calibration and configuration storage.

1.2.5 Physical Dimensions

Case Dimensions

Width:	730 mm (29.8")
Height:	260 mm (10.2 ") plus inlet and vent connections
Depth:	240 mm (9.5")
Weight:	14.1 kg

1.2.6 Certifications

TBA

1.3 Nomenclature

Span	When gas of known Rayleigh factor is passed through the instrument and measured as a reference. This is often used to perform a precision check or calibration of the upper range of the instrument.
Zero	When air with no particulate matter is passed through instrument and measured as a reference. This measurement is used to ascertain the effect of air (CO2, CO etc) on scattering coefficient. This is often used to perform a precision check or calibration of the lower range of the instrument.
Calibration	The process of adjusting the instrument using a reference of span or zero to ensure the correct measurement of light scattering.
Zero Noise	This is the calculated standard deviation of the scattering measurements during a zero process.
σ_{sp}	The scattering of light due to particles. This is the measurement made by the instrument.
LED	Light Emitting Diode. Used as a source of light at a specific wavelength.
LCD	LCD (Liquid Crystal Display) is a type of display module.
Vent	Used as an exhaust path for the calibration gas during span precision checks or calibrations at ambient pressure.
Sample Air	Sample air is defined as the unfiltered sample that enters the instrument to be measured. It is drawn through the system via the sample pump and exhausted out the exhaust port.
Exhaust Air	Exhaust air is the sample air after it has passed through the measurement cell or bypass valves and expelled out of the instrument via the sample pump.
ID and OD	These are measurements of tubing. ID is the internal diameter of tubing, OD is the outer diameter.
Multidrop	A configuration of multiple instruments connected via the same RS232 cable.
Photomultiplier Tube	A highly sensitive device which can detect extremely low levels of light (photons) and multiply the electrical signal to a point where it can be accurately measured. This is often referred to as a PMT.

Bootloader	A program that checks whether the current firmware is valid, executes the instrument warm-up. The bootloader can be entered from the Factory menu. The bootloader enables various low level recovery tools, including updating the firmware from a USB stick.
PCA	Printed Circuit Assembly. An electronic circuit mounted on a printed circuit board to perform a specific electronic function.
Slpm	Standard litres per minute. This is the flow referenced to standard temperature and pressure conditions. For the purposes of this manual, all flows are referenced to 0 °C and 101.3 kpa (1 atm).
Lpm	Volumetric litres per minute. This is the volumetric flow corrected for ambient temperature and pressure conditions.
Widget	An application, or a component of an interface, that enables a user to perform a function or access a service.

1.4 Background/Theory

Aerosol and cloud scattering/absorption of light are one of the main influences on solar radiation penetration into the lower parts of the Earth's atmosphere. Nephelometers have predominantly been used to measure light scattering and determine solar radiation entering the Earth's atmosphere A traditional multi wavelength backscatter nephelometer would allow a researcher to accurately estimate both the total scatter of light by aerosols and how much of this scatter is backscatter (scattered back towards the source).

The Aurora NE Series Multi Wavelength Nephelometers has been specifically designed with a backscatter shutter that is able to be positioned at any angle between 10° and 90° with up to 20 different angles (including 0°) per measurement cycle.
This more comprehensive look at scattering allows a user to measure the scattering from say 20° to 170° at one measurement angle, then at 30° to 170° at another angle. The user can then determine the specific scattering within the 20° to 30° sector.

The ACOEM Aurora NE Series Multi Wavelength Nephelometers measures σ_{sp}, the scattering coefficient of light due to particles at three wavelengths 450 nm, 525 nm, 635 nm.
The measurement of σ_{sp} may be used as a measure of aerosol scattering, the higher the value of σ_{sp} the more light scattering that occurs.
The dimension of σ_{sp} is inverse length. The Aurora NE Series Multi Wavelength Nephelometers reports σ_{sp} in units of the inverse mega metre (Mm^{-1}) = 10^{-6} m^{-1} (inverse metres).
1 Mm^{-1} = 10^{-3} km^{-1} (inverse kilometres) = 10^{-6} m^{-1} (inverse metres).

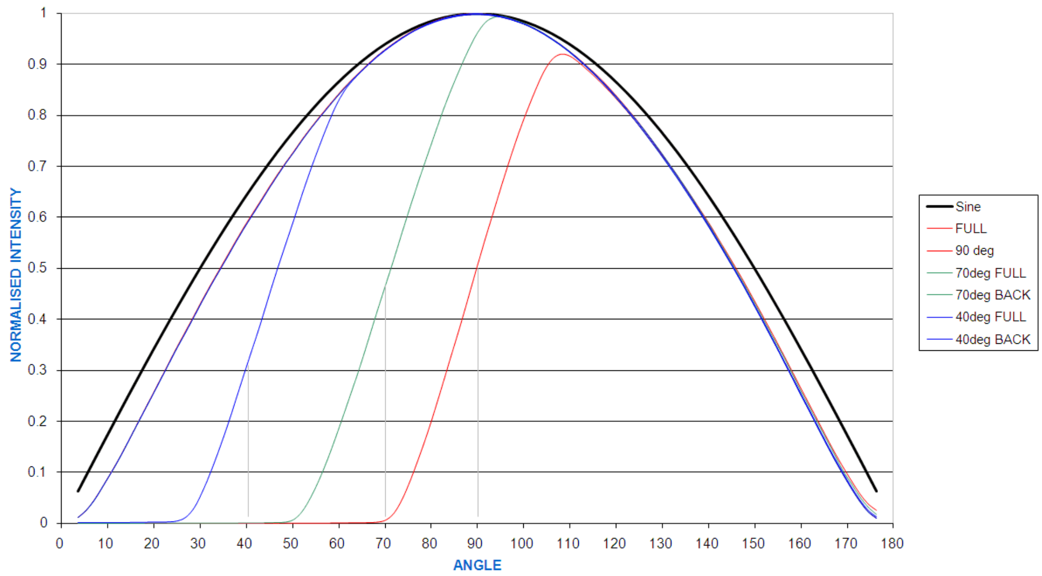


Figure 1 – Graphical Demonstration of Backscatter Measurements at 40°, 70° and 90°

1.4.1 Background – Light Scattering

1.4.1.1 Extinction Coefficients (σ_{ext})

Attenuation of light (that is, reduction in its intensity) is usually expressed using the Beer-Lambert law:

$$I = I_0 e^{-\sigma_{ext} x}$$

Equation 1 Beer-Lambert Law

where:

I_0 = initial light intensity,
I = intensity after distance x,
X = distance,
σ_{ext} = the attenuation, or extinction coefficient.

Note: Sometimes the symbol b is used instead of σ_{ext}.

(sometimes the symbol b is used instead of σ_{ext})

The relationship between extinction coefficient and visual range is expressed in Koschmieder's Formula.

$$L_v = 3.912/\sigma_{ext}$$

Equation 2 Koschmieder's Formula

where:

L_v = visual range,
σ_{ext} = extinction coefficient.

The larger the value of σ_{ext}, the more rapidly the light is attenuated (i.e., reducing visibility).

1.4.1.2 Assumptions

Light may be attenuated either by scattering off objects or by absorption by objects. Thus, the extinction coefficient σ_{ext} may be broken down into a scattering coefficient σ_{scat} and an absorption coefficient σ_{abs}:

$$\sigma_{ext} = \sigma_{scat} + \sigma_{abs}$$

Equation 3 Light Attenuation Equation

For light attenuation in the atmosphere, the objects responsible can be either gas molecules or airborne particles. The scattering and absorption coefficients may therefore be further broken down into:

$$\sigma_{scat} = \sigma_{sg} + \sigma_{sp}$$

Equation 4 Scattering Coefficient

and $$\sigma_{abs} = \sigma_{ag} + \sigma_{ap},$$

Equation 5 Absorption Coefficient

where the subscripts denote:

- s: scattering
- a: absorption
- g: due to gas molecules
- p: due to particulate matter.

σ_{sp}, for example, is the extinction coefficient due to scattering from particulate matter. Scattering due to gas molecules (coefficient σ_{sg}) is also called 'Rayleigh scattering'.

NO_2 is the most significant gaseous absorber and soot the most significant particulate absorber. However, except in extremely high concentrations, the effects of absorption are negligible compared to the effects of scattering. Therefore, to a very good approximation,

$$\sigma_{ext} \approx \sigma_{scat} = \sigma_{sg} + \sigma_{sp}.$$

Equation 6 Relationship of Extinction Coefficient with Scattering Coefficient

It is σ_{scat} that the Aurora NE Series measures directly. When the instrument performs a zero adjust in particle-free air (that is, where only Rayleigh scattering is present), the σ_{sg} component of σ_{scat} is subtracted leaving σ_{sp} as the reported parameter.

Higher particulate concentrations mean more scattering, so σ_{sp} is a good measure of particulate pollution.

In urban situations σ_{sp} will be much greater than Rayleigh scattering (σ_{sg}). σ_{sp} is therefore also a good measure of atmospheric visibility.

1.4.1.3 Effects of Wavelength

Absorption and scattering are dependent on the wavelength of the incident light. The Aurora NE Series uses a light source emitting light at three different wavelengths (infrared to ultra-violet). The three wavelengths (red 635 nm, green 525 nm and blue 450 nm) all produce differential scattering and are affected differently by particles of different size, shape and composition.

- 450 nm (blue) interacts strongly with fine and ultrafine particulates (e.g., wood fires and automobiles).
- 525 nm (green) interacts strongly throughout the human range of visibility (e.g., smog, fog and haze).
- 635 nm (red) interacts strongly with large particulate matter (e.g., pollen and sea salt).

This allows partial characterisation and in-depth analysis of the type of particulates and their effects within the environment. These different wavelengths overlap in measurements and do not directly measure differences in particulate composition.

1.4.1.4 Effects of Humidity

Above about 60% relative humidity, particles collect water droplets and grow because of the water vapour condensing on them, hence scattering more light.

Thus the Aurora NE Series is equipped with a sample heater that if enabled will heat the sample as its humidity approaches the target setpoint as defined by the user. This decreases the relative humidity and evaporates the water droplets.

Switching on the heater (dry measurement) would give a more reliable measure of airborne pollutant concentrations, as this evaporates (much of) the water droplets. Switching off the heater (wet measurement) would give a more reliable measure of true scattering of aerosols.

1.4.2 Measurement Theory

During normal operation there are three main measurements being made. They are Dark count, Shutter count and Measure count.

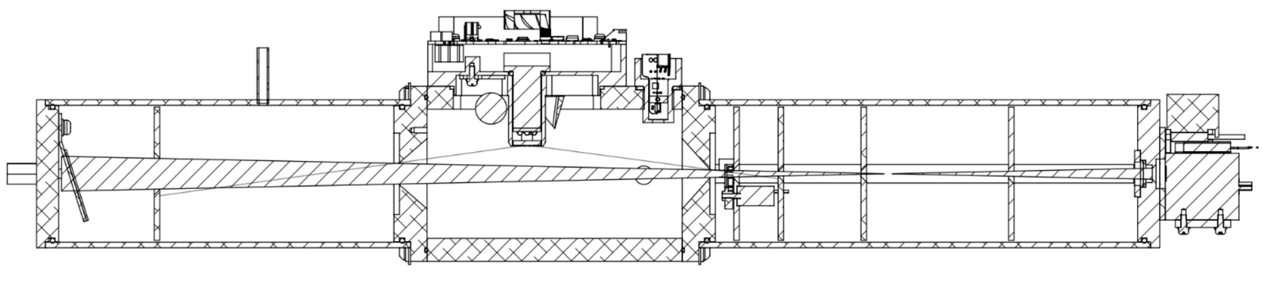


Figure 2 – Light Path Layout, Without Backscatter

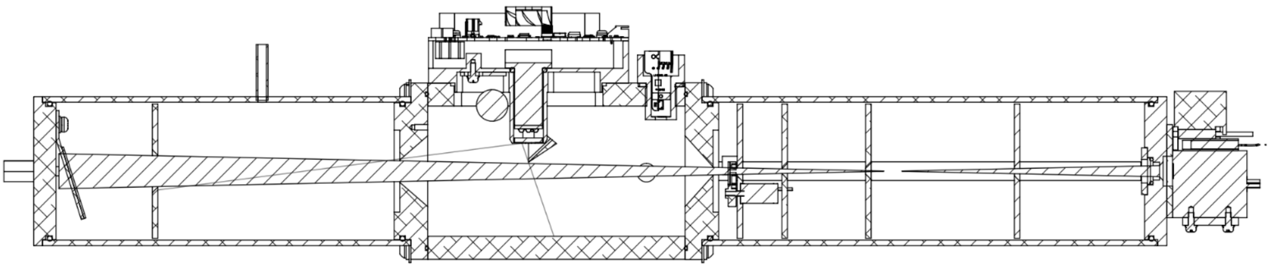


Figure 3 – Light Path Layout, With 90° Backscatter

1.4.2.1 Shutter Count

Periodically the reference shutter mounted inside the cell is closed for a number of seconds. During this time there is a direct light path from the light source, to the shutter and then to the PMT. The shutter glass is made of a material with a known transmittance that allows the Aurora NE Series to adjust for variations in the measuring system. This measurement does not rely on air scattering. The results from the shutter measure are stored as the **shutter count** and should be in the order of 1M to 10M for each wavelength.

1.4.2.2 Dark Count

The light source periodically flashes on and off in less than 1 second. When the light source is off, the PMT measures the **dark count**. That is, the background light incident upon the PMT when the light source is off. Ideally, this value should be 0, however readings up to 5,000 are possible, as are small fluctuations.

1.4.2.3 Measure Count

The measure count is taken when the shutter is open and the light source is on. The measured counts from the PMT are a result of scattering due to gaseous and particulate matter inside the measurement volume. As the concentration of scattering components inside the cell increases, so do the measure counts. Typical measure counts can vary from 10,000 to 500,000. The measure count is measured for each wavelength and the dark count is subtracted. The measure count will be at its lowest during zero measurement which should be at least 10,000 for each wavelength.

1.4.2.4 Measure Ratio

The measure ratio (MR) is the ratio between the Measure count (C_m) and the shutter count (C_{sh}).

$$MR = \frac{C_m}{C_{sh}}$$

e.g., If C_m = 15,000 & C_{sh} = 1,200,000, then MR = 12.5 x 10^{-3}.

Because the C_{sh} is a stable known source, the MR is directly proportional to σ_{scat}.

If there are changes in the measurement system (i.e., Light source intensity or temperature), then both C_m & C_{sh} will change proportionally. Therefore, the MR will remain constant. However, if the σ_{scat} of the sample changes, then only the C_m will vary.

1.4.2.5 Measurement sequence

During measurement the light source sequentially emits a short pulse of light (red, green, blue) one at a time. This sequence is repeated for every angle. This process measures the dark count, measure count and measure ratio are all calculated every cycle. The shutter count is calculated at regular intervals depending on the instrument settings. These measurements along with stored parameters allow the Aurora to calculate σ_{sp} for every angle at every wavelength.

1.5 Instrument Description

The major components of the Aurora NE Series Multi Wavelength Nephelometers are described below:

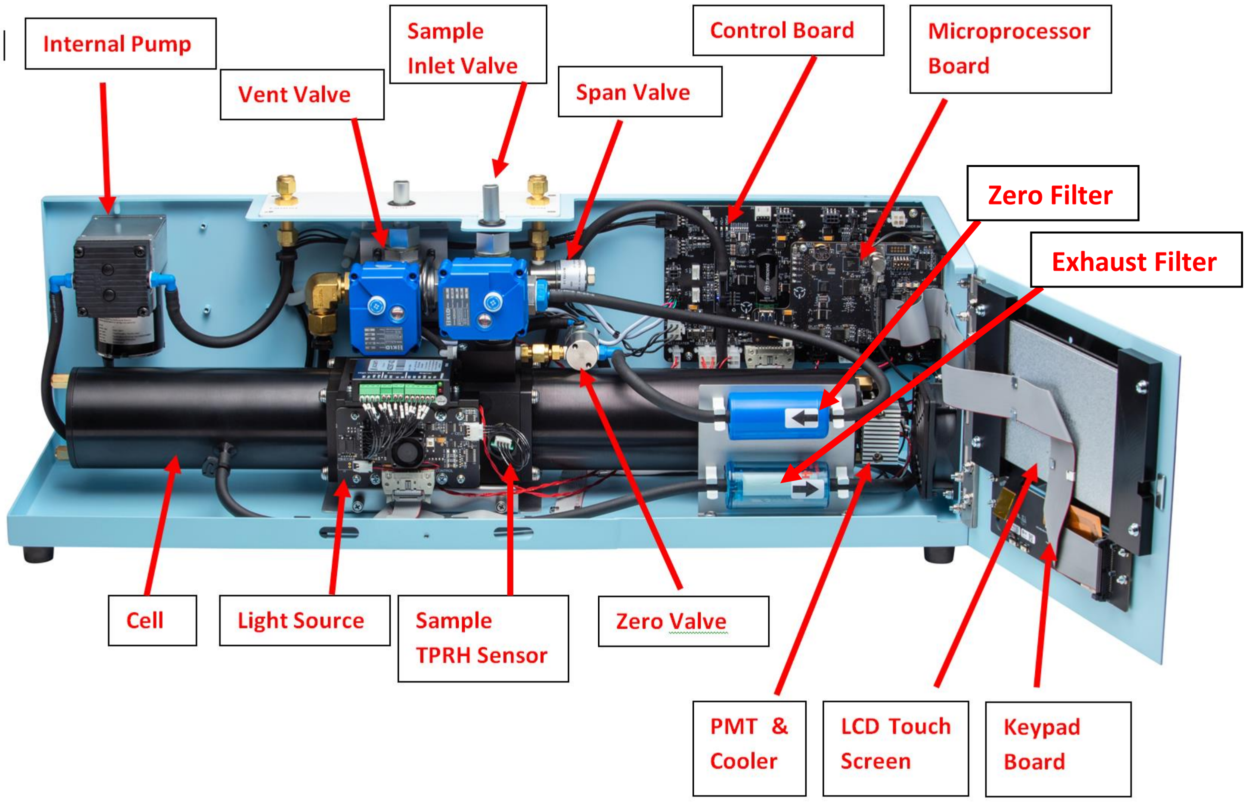


Figure 4 – Major Components of Aurora NE Series

1.5.1 Main Enclosure

The main enclosure is a sturdy aluminium construction with powder coating for additional protection. The LCD and keypad are mounted on a hinged door for easy access to the filters without removing the cover.

1.5.1.1 Removable Cover

The removable cover should always be installed during normal operation for optimal performance. When required for service and maintenance, the cover can be removed by removing the three mounting thumb screws.

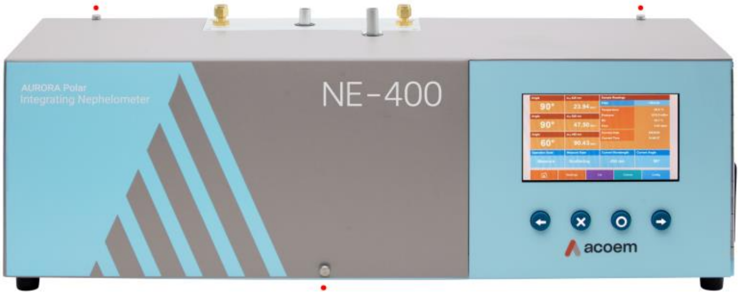


Figure 5 – Mounting Screw Locations

1.5.2 Power Supply

The external, auto ranging power supply is rated at 100 to 250 VAC, 50 or 60 Hz. This means that it a can be connected to any domestic mains supply anywhere in the world via a standard IEC mains connector. The output is 24 VDC at 6.67 A Max.

Figure 6 – 24 VDC Power Supply

1.5.3 Measurement Cell Assembly

The measurement cell assembly is made up of a number of sub components. Each one is described below.

1.5.3.1 Measurement Cell

The measurement cell is a critical part of the Instrument. It is within the cell that the optics, the electronics and the pneumatics all come together. The cell is pneumatically and optically sealed to prevent stray light and air from entering. It is made of black anodised aluminium with a special coating of matt black paint on the inside to reduce internal light reflections.

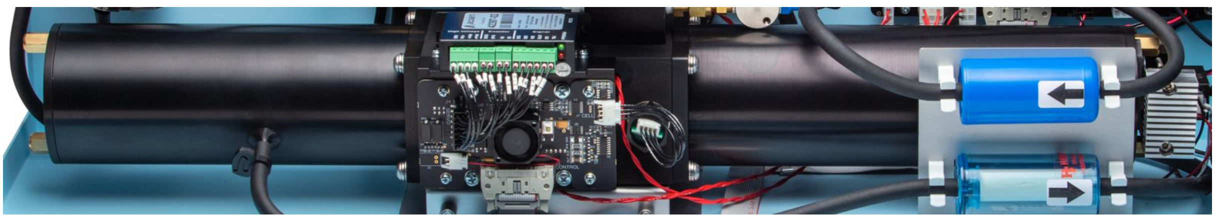


Figure 7 – Measurement Cell

1.5.3.2 PMT/Cooler Assembly

The PMT (Photo Multiplier Tube) is used to measure the light (photons) resulting from scattering. It is actually a photon counting head and produces an electrical signal (frequency) proportional to the incident light. The output frequency of the PMT ranges from 0 Hz to 10,000,000 Hz. The High voltage supply to operate the PMT is internally generated within the PMT.

Figure 8 – PMT/Cooler Assembly

The Cooler assembly mounted on the PMT is used to keep the PMT to a lower temperature during normal operation. This will reduce the noise of the PMT. The Cooler temperature is measured using a thermistor near the PMT.

1.5.3.3 Sample Heater

The sample heater (when enabled), controls the temperature or RH of the sample measurement. There 2 sets of heaters. One on the cell body and one on the sample inlet just below the inlet valve. The sample temperature and RH sensor is mounted in the cell next to the light source wall.

The microprocessor controls the duty cycle of the sample heater so that the sample air in the cell is kept at the desired set point for temperature or RH.

Figure 9 – Sample Heater Location

1.5.3.4 Light Source Assembly

Figure 10 – Front View of Light Source Assembly

Figure 11 – Back View of Light Source Assembly

1. Light Source Housing
2. Polar Shutter Servo Motor
3. Polar Shutter Arm
4. LED Heatsink Assembly
5. Opal Glass Diffusor
6. Servo Motor Controller
7. Light Source/Servo Control PCA

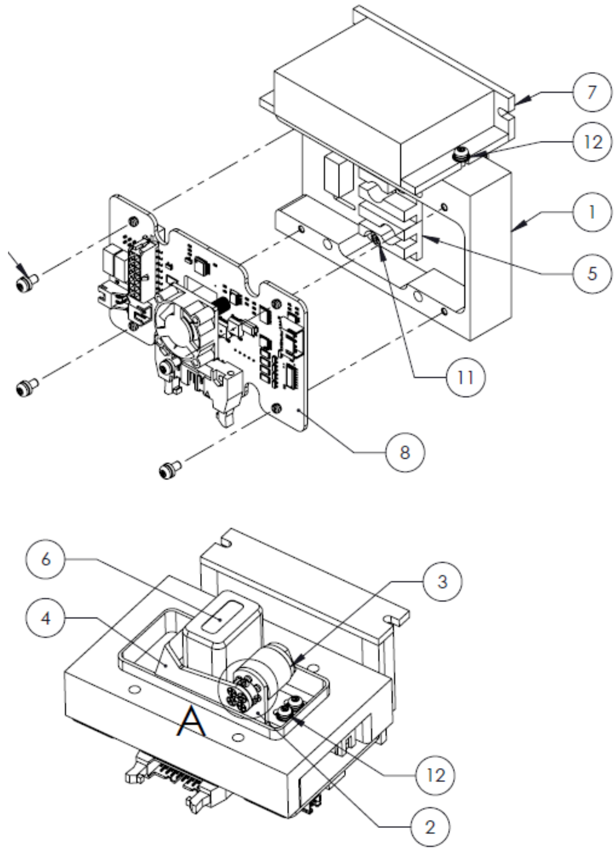


Figure 12 – Light Source Assembly Exploded Diagram

The light source uses an array of high-powered LEDs (Light Emitting Diodes) of specific wavelengths (red 635 nm, green 525 nm, blue 450 nm). LEDs are used because they provide a stable source of light with better reliability. They are mounted on a heatsink (2) so that the heating of the sample is kept to a minimum. Integration can be performed over varying periods of time for increase accuracy. LEDs can be enabled for longer periods and respond very fast when enabled for short periods. The array of LEDs produces a high intensity of light for greater accuracy.

The LED array is housed in a black assembly (1) which can be easily removed for cleaning purposes. On the front of the light source housing there is an opal glass diffuser (6). This diffuser ensures that the LEDs produce light with a repeatable Lambertian distribution.

The Polar Shutter (4) moves in and out of the light path to different locations so that the amount of light in integrated over different angles between 0° and 90°. The shutter is moved by a servo motor (3) which is controlled by the motor controller (7).

The Intensity of the LEDs is controlled by the light source/servo control PCA (8) and is stored on this board along with other light source calibration data using internal memory.

1.5.3.5 Sample Temperature/Pressure/RH Sensor

Accurate measurement of the sample temperature, pressure and RH is measured using the digital TPRH sensor. It’s mounted on the front side of the measurement cell for easy access and connects to the light source assembly control PCA located beside it.

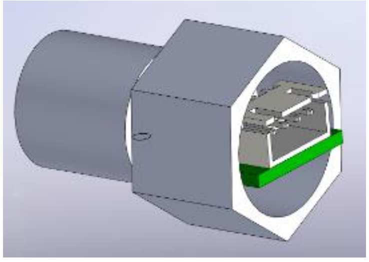


Figure 13 – Sample Temperature/Pressure/RH Sensor

1.5.3.6 Reference Shutter

The reference shutter is used to periodically check the operation of the Aurora NE Series as well as compensate for any variations in the light source intensity. The reference shutter composes of a rotary solenoid and a glass diffusor with known transmittance. It is mounted on a rotary solenoid and is switched in and out of the optical path. Typically, when the shutter is switched in it will give a shutter count of around 1M - 5M (though this number can vary depending on PMT sensitivity and light source intensity).

Figure 14 – Reference Shutter Assembly

1.5.4 Microprocessor & Control PCA

The microprocessor and control PCA's are the heart of the Aurora NE Series. The microprocessor PCA takes the raw count data from the PMT and converts them to real σ_{sp} values. It internally logs the data and stores it on the SD card or USB memory stick It provides RS232, USB, Ethernet communications as well as analog and digital I/O signals. The microprocessor PCA controls the colour touchscreen LCD and buttons allowing the user to view and modify all system parameters. The firmware (program) loaded on the microprocessor PCA can be upgraded via the USB memory stick. It also contains a real time clock for data logging and automatic calibration control. The calibration parameters and user settings are also stored in the onboard FLASH and can be saved or uploaded from the SD or USB memory stick.

The control PCA controls all the pumps, valves heaters and light source. It also has an onboard flow sensor to measure the sample flow. The control board provides stable power to the various components and includes an electronic fuse for protection.

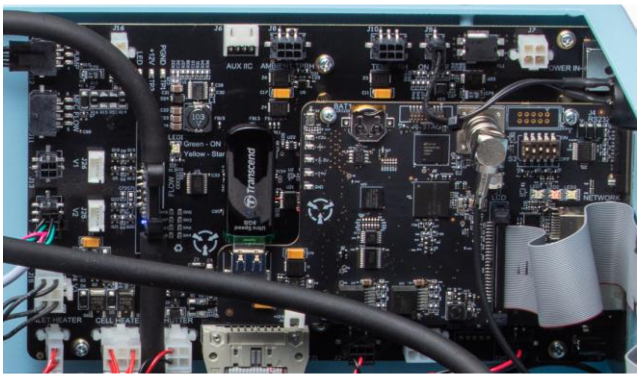


Figure 15 – Microprocessor PCA and Control PCA

1.5.5 Inlet Ball Valve

The inlet valve is a +12 V motor actuated ball valve which is operated during span and zero calibrations. The Inlet valve works in conjunction with the other valves to bypass the sample flow around the measurement cell during the calibration while still maintaining constant flow at the inlet to the instrument. This is important when the sample inlet is connected to a common manifold that is shared by other aerosol instruments.

1.5.6 Vent Ball Valve

The vent valve is a +12 V motor actuated ball valve which is operated during span calibrations. The vent valve works in conjunction with the other valves to bypass the sample flow around the measurement cell during the calibration while still maintaining constant flow at the inlet to the instrument. The vent valve provides a vent path for the calibration gas to flow through the measurement cell at ambient pressure.

1.5.7 Span Valve

The span valve is a +12 V solenoid valve which is opened during a span calibration or span precision check to allow the calibration gas air to pass into the measurement cell for calibration. This valve works in conjunction with the other valves to perform the calibration.

1.5.8 Zero Valve

The zero valve is a +12 V solenoid valve which are opened during a zero calibration or zero precision check to allow the sample air (via the zero filter (refer to Section 1.5.10)) to pass into the measurement cell during zero calibration or zero precision checks. This valve works in conjunction with the other valves to perform the calibration.

1.5.9 Internal Sample Pump

The internal sample pump is a 24 V brushless diaphragm pump which provides years of reliable operation. The internal pumps speed is controlled by the microprocessor PCA and the flow is measured by the on-board flow sensor mounted on the control PCA to provide an accurate flow control loop. The internal sample pump can be set to a flow between 2 - 8 slpm for reliable flow control.

1.5.10 Zero Filter

The zero filter works in conjunction with the sample pump and valves to provide the particle free air during a zero calibration and zero precision check. Its filtration efficiency is 100% removing particles down to 0.01 micron in size.

1.5.11 Sample Exhaust Filter

The sample exhaust filter is located on the exhaust of the measurement cell and is used to remove particulates from the sample air so as not to contaminate the flow sensor and sample pump. Its filtering element is visible making it easy to see when it is dirty and in need of replacement.

Its filtration efficiency is greater than 95% removing particles down to 0.1 micron in size.

1.5.12 Colour Touchscreen Display

The Aurora NE Series Multi Wavelength Nephelometers uses a colour touchscreen LCD and buttons to simply navigate through the menu structure. This allows the user to set up many of the features of the instrument as well as providing real-time visual status of the instrument's performance. The four buttons on the front panel and the LCD all interface to the LCD/Keypad PCA and all the signals are transferred via the flat ribbon cable to the microprocessor PCA.

1.5.13 External Connections

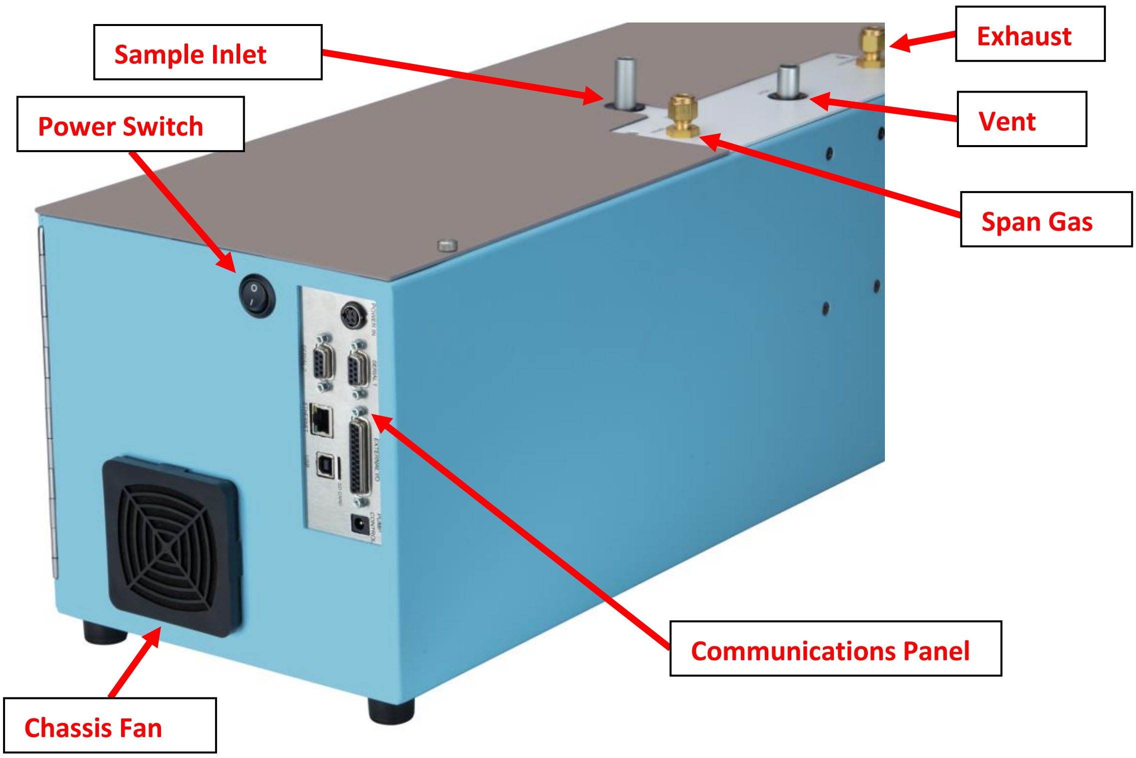


Figure 16 – External Connections Diagram

1.5.13.1 Power Switch

Shuts down the internal power supplies and systems. When the switch is off, there is still +24 V power internally.

1.5.13.2 Sample Inlet

The 1/2" aluminium port is where the main sample inlet is connected. The inlet has an O-ring seal and can be removed and replaced with a longer inlet tube if required. During transport or storage, this port should be closed with the supplied black rubber caps to prevent insects and debris from getting into the cell.

1.5.13.3 Vent Outlet

This 1/2" aluminium port is where span gas is vented during a span calibration or span precision check. It provides a path for the calibration gas to purge through the cell without restriction. The vent can be connected to additional1/2" tubing if the calibration gas is required to be vented outside the room. The vent has an O-ring seal and can be removed and replaced with a longer inlet tube if required. During transport or storage, this port should be closed with the supplied black rubber caps to prevent insects and debris from getting into the vent ball valve.

1.5.13.4 Span Gas

This 1/4" brass fitting is used for connecting the calibration (span) gas to the instrument. Refer to Section 5 for instructions on the correct connection of the calibration setup.

1.5.13.5 Exhaust

This 1/4" brass fitting is where the exhaust from the internal pump exits the instrument. It can be left disconnected. If additional noise suppression from the pump is required, then a longer length of tubing can be connected here.

If the MFC and external pump option is installed, then this 1/4" brass fitting is where the external pump pneumatic tube is connected to.

1.5.13.6 Chassis Fan

The chassis fan on the PMT end of the enclosure is used to remove heat generated by the PMT cooler assembly. If the cooler is not enabled, then the chassis fan can also be used to keep the internal chassis temperature of the instrument lower. This is important when wanting to minimise the difference between sample and chassis temperature. The chassis fan can be enables and disabled in the hardware menu. It is operated at 24 VDC and has protective grills.

1.5.13.7 Power & Communications Panel

Communication between the instrument and either a data logger, laptop, network or other system device can be performed with the following communication connections located on the side panel. The main 24 V power supply connects into a 4-pin receptacle located at the top of the side panel as well as a DC jack used for the external pump control, located at the bottom of the side panel.

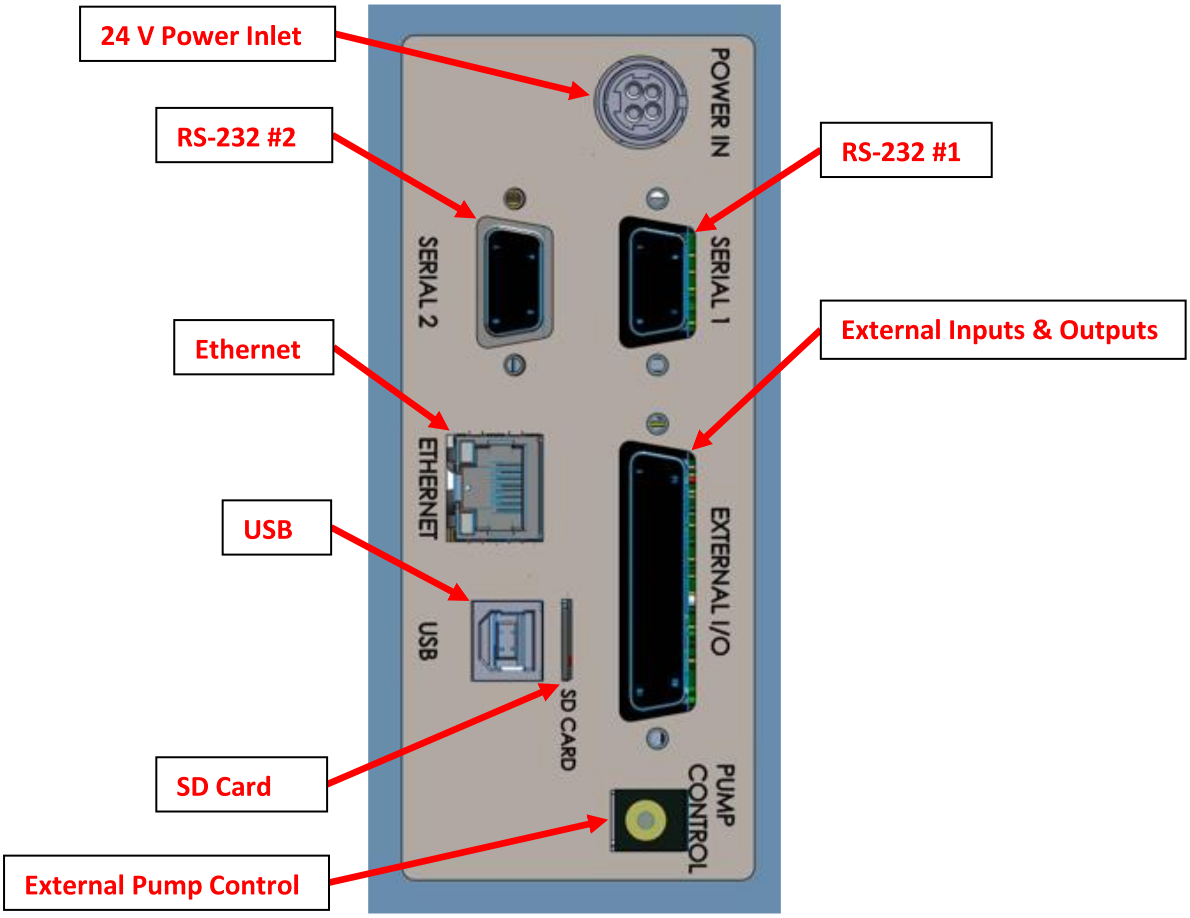


Figure 17 – Power and Communication Panel Diagram

POWER IN

The power inlet is where the 24 V external power supply is connected. This supplies all the power for the instrument. The Power switch is located next to the connector and must also be turned on (switched down) for the instrument to operate.

SERIAL 1

This port is a multi-drop serial port and can be used for simple RS-232 communication with a data logger or for data download.

SERIAL 2

This port is a multi-drop serial port and can be used for simple RS-232 communication with a data logger or for data download.

USB

This port can be used for communication with the instrument through a standard USB type B connection.

SD CARD

The SD CARD is used to store logged data, configuration files and event files. It can be removed and the data copied onto a computer.

TCP/IP Network

This port is best used for remote and real-time access to the instrument when a network is available.

External I/O

The analog/digital port sends and receives analog/digital signals to and from other devices. These signals are commonly used to activate external devices or provide warning alarms.

Analog Outputs

The instrument is equipped with six user definable analog outputs. The outputs are menu selectable as voltage outputs of 0 - 5V for each.

Analog Inputs

The instrument is also equipped with four analog voltage inputs (0 - 5 VDC CAT 1) with resolution of 16 bits plus polarity.

CAUTION

Exceeding these voltages can permanently damage the instrument and void the warranty.

Digital Status Inputs

The instrument is equipped with four logic level inputs (0 - 5 VDC CAT 1) for the external control of zero/span calibration sequences or other states.

CAUTION

Exceeding these voltages can permanently damage the instrument and void the warranty.

Digital Status Outputs

The instrument is equipped with four open drain outputs, which will convey instrument status conditions and warning alarms such as no flow, sample mode, etc.

CAUTION

Exceeding 12 VDC or drawing greater than 400 mA on a single output or a total greater than 2 A across the four outputs can permanently damage the instrument and void the warranty.

External Pump Control

This output is used to control the external pump controller kit for when an external pump is used in conjunction with the MFC option. Contact ACOEM for more details.

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2. Installation

2.1 Initial Check

Packaging

The Aurora NE Series is transported in packaging specifically designed to minimise the effects of shock and vibration that may occur during transportation. Acoem Australasia recommends that the packaging be kept if there is a likelihood that the instrument is going to be relocated.

Note: The black and red caps that seal the pneumatic connections during transport must be removed prior to operation. It is suggested that these caps be stored in a ziplock bag and placed inside the chassis for future use when relocation or storage of the instrument is required.

Items Received

With the delivery of the Aurora NE Series, the user will receive the following:

Table 3 – List of Items Received

Item Name	Part No.	Image
Aurora NE-400, NE-300 or NE-100	E010107, E010104 or E010101	Refer to Figure 18, callout 7.
24 V Power Supply	P010023	Refer to Figure 18, callout 11.
Green Ecotech Resources USB Stick	H030137-01	Refer to Figure 18, callout 10.
Manual (hardcopy optional)	M010068	-
SD Memory Card 32GB	H030136	Refer to Figure 18, callout 9.
USB Cable	COM-1440	Refer to Figure 18, callout 8.
Data Sheet/Calibration Report		Refer to Figure 18, callout 12.
Power Lead (120 V)*	C040007	Refer to Figure 18, callout 2.
Power Lead (240 V)*	C040006	Refer to Figure 18, callout 1.
	C040008	Refer to Figure 18, callout 3.
	C040009	Refer to Figure 18, callout 4.
	C040010	Refer to Figure 18, callout 5.
	C040054	Refer to Figure 18, callout 6.

*The power lead received depends on the power supply of the country (120 V or 240 V).

Note: Check that all these items have been delivered undamaged. If any item appears damaged, contact your supplier before turning the instrument ON.

Note: It is recommended to kept packaging material for transport or storage purpose.

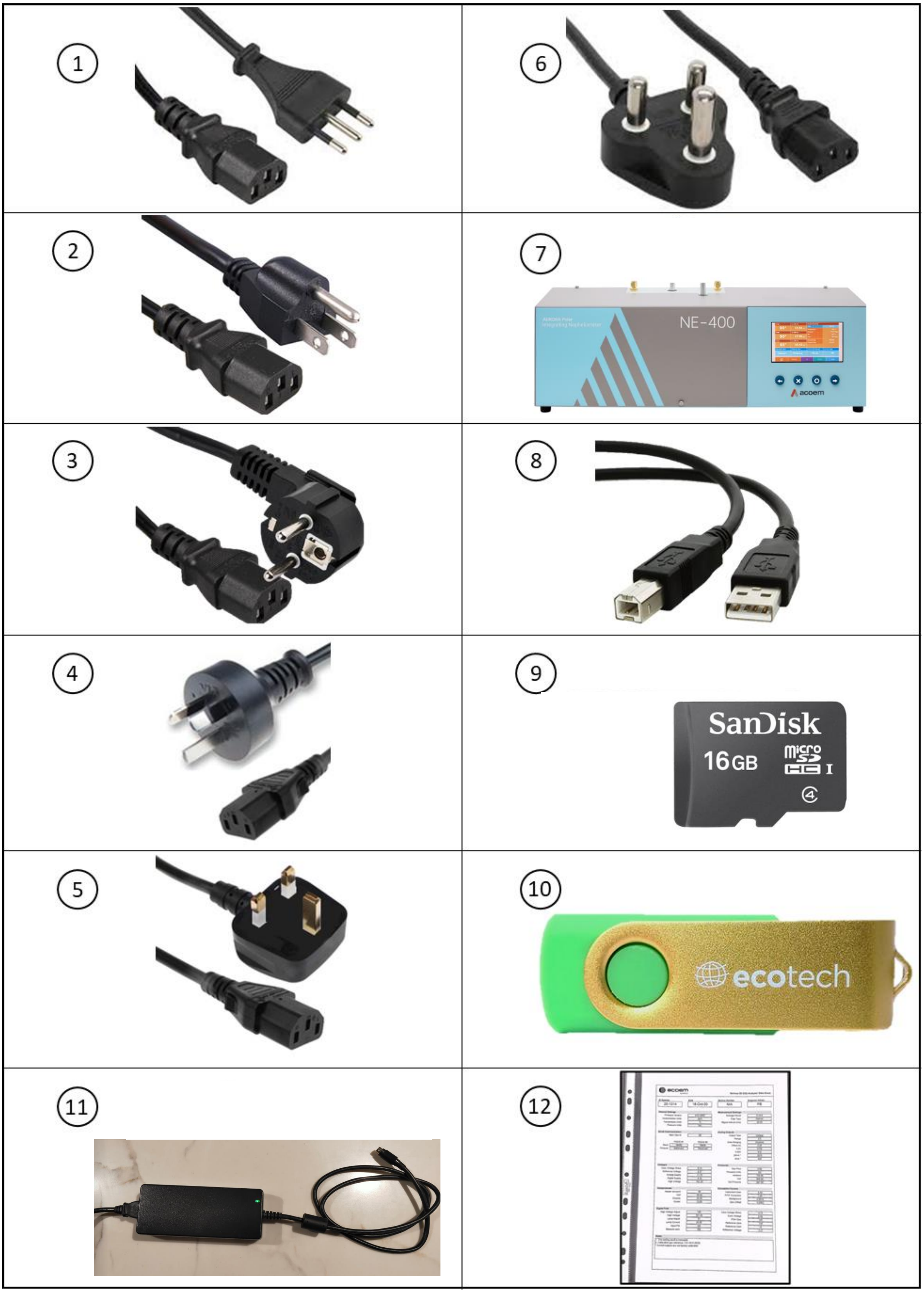


Figure 18 – Received Items

2.1.1 Opening the Instrument

Check the interior of the instrument by opening the front door of the enclosure. The door has a magnetic latch and can be opened by lightly pressing the door inwards and letting it spring open. Check that all pneumatic and electrical connectors are connected and that there are no loose items inside. If any visible and obvious damage exists, contact your supplier and follow the instructions in claims for Damaged Shipments and Shipping Discrepancies at the front of this manual.

Check the interior of the instrument with the following steps:

1. Refer to Figure 19. Remove the transit thumb screw located on the front door.

Figure 19 – Transit Thumb Screw Location

2. Refer to Figure 20 . Open the front door. The access panel is held in place by a magnetic latch and can be opened by lightly pressing the panel inwards and letting it spring open.

Figure 20 – Front Door Release Location

Figure 21 – Front Access Panel Open

3. Refer to Figure 22. Remove the three thumb screws from the chassis lid and lift upwards.

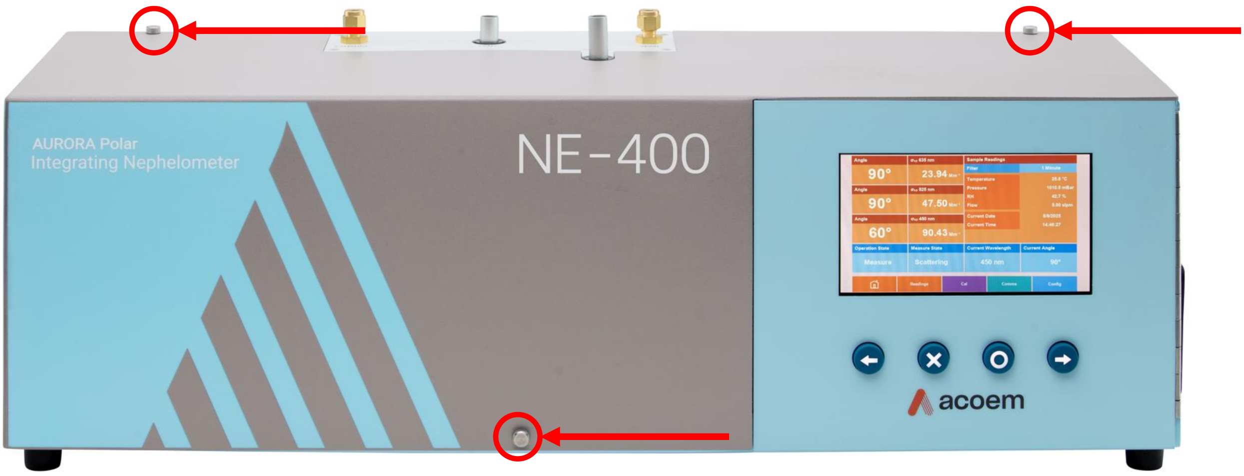


Figure 22 – Chassis Lid Thumb Screw Location

4. Refer to Figure 23. Lift the lid vertically and evenly upwards until it is clear of the chassis.

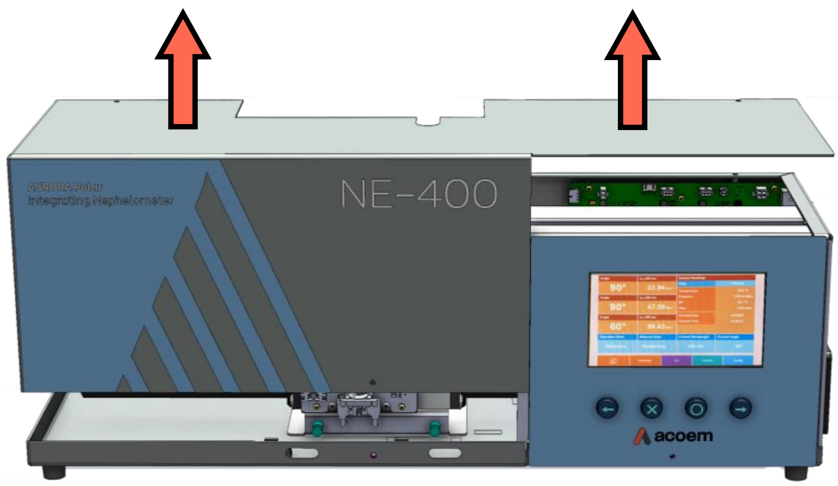


Figure 23 – Removing the Lid

5. Check that all pneumatic and electrical connectors are connected and that there are no loose items inside. If any visible and obvious damage exists, contact your supplier and follow the instructions in claims for Damaged Shipments and Shipping Discrepancies at the front of this manual.

2.2 Installation Notes

When installing the instrument, the following points must be taken into account:

- For best results and long-term reliable operation, the instrument should be located in a temperature controlled environment (air conditioned shelter) with minimal dust exposure and moisture build up.
- The instrument should be mounted on a stable table top or can be wall mounted using the optional wall mount bracket.
- The instrument should not have anything placed on top of it or touching the case.
- Instruments should be sited with easy access to the front display and the right-side panel (fan) should be unobstructed.
- The enclosure lid should be installed during normal operation.
- The sample inlet of the instrument can be connected to a common sample manifold designed for particulate sampling or it can have its own sample inlet. In either situation, make sure that there are no sharp bends or long horizontal lengths along the sample path.
- Follow local guidelines for suitable location of the sample inlet siting position.

Note: The power ON/OFF switch is accessible from the side of the instrument only. Install the instrument so that the ON/OFF power switch is accessible.

2.3 Instrument Set-up

After installing the instrument, the following procedures should be followed to ready the instrument for monitoring.

2.3.1 Power Connections

CAUTION

Always unplug the equipment prior to removing or replacing any components.

CAUTION

Do not replace the detachable mains supply cord with an inadequately rated cord. Any mains supply cord that is used with the instrument must comply with the safety requirements (250 V/10 A minimum requirement).

CAUTION

Ensure that the mains supply cord is maintained in a safe working condition.

CAUTION

When connecting the mains power to the instrument, the following must be adhered to otherwise the safety and the reliability of the instrument may be compromised.

- A three pin mains power lead with a protective earth conductor **MUST** be used.
- The mains power outlet (wall socket) must be in the range of 100 - 240 VAC, 50 - 60 Hz.
- The mains power outlet must be protected by an earth leakage protection circuit.
- Use only the supplied 24 V power supply pack supplied with the instrument.
- Plug the 4-pin connector of the power supply into the Power In connector on the side panel. Refer to Figure 17.
- The power switch is located next to the Power In connector and must also be turned on (switched down) for the instrument to work.

2.3.2 Pneumatic Connections

Figure 24 – Pneumatic Ports

There are four pneumatic port connections on the Aurora NE Series SPAN, SAMPLE, VENT and EXHAUST.

Span Port

The span port is connected to the calibration (span) gas delivery system. See the calibration section instructions on the correct setup and connection of the calibration gas (refer to Section 5). This uses a 1/4" brass fitting which must be fastened tightly to make sure no calibration gas can leak out.

Sample Port

The 1/2" aluminium port is where the main sample inlet is connected. The inlet has an O-ring seal and can be removed and replaced with a longer inlet tube if required. During transport or storage, this port should be closed with the supplied black rubber cap to prevent insects and debris from getting into the cell.

Vent Port

This 1/2" aluminium port is where span gas is vented during a span calibration or precision check. It provides a path for the calibration gas to purge through the cell without restriction. The vent can be connected to additional 1/2" tubing if the calibration gas is required to be vented outside the room. The vent has an O-ring seal and can be removed and replaced with a longer inlet tube if required. During transport or storage, this port should be closed with the supplied black rubber cap to prevent insects and debris from getting into the valve.

Exhaust Port

This 1/4" brass fitting is where the exhaust from the internal pump exits. It can be left un connected. If additional noise suppression from the pump is required, then a longer length of tubing can be connected here.

CAUTION

The exhaust port is pressurised and should never be blocked or restricted.

2.3.3 Communications Connections

There are a number of ways to communicate with the instrument, refer to Section 4 for further detail.

2.3.4 Instrument Set-up

The Aurora NE Series Multi Wavelength Nephelometers will be delivered in a default configuration that in most installations will be suitable. The user may want to change some settings to suit their specific needs or regulations. Listed below are the factory settings.

Instrument Setting	Factory Setting	Manual Section
Normalisation Temperature	0°C	Refer to section 5
Sample Flow	5.0 slpm	
Sample Heater	Off	
Cooler Temperature	>20°C	
Calibration Gas	CO_2	Refer to section 5
Calibration Time	20 minutes	Refer to section 5
Number of Angles	18	Refer to section 5
Filtering	Rolling Average	

The instrument is shipped fully calibrated. Transportation, vibration and atmospheric conditions may cause some short-term drift in the instrument's calibration. On initial power up the instrument measurements should be close to what is expected. It is good to check for any abnormal readings or errors that may arise from transportation by operating the instrument for a couple of hours. However, if the instrument is being setup for long term measurements, then a full calibration must be performed.

2.4 Transporting/Storage

Transporting and storage of the instrument should be done with great care. It is recommended that the packaging the Instrument was delivered in should be used when transporting or storing.

When transporting or storing the instrument the following points should be followed:

1. Turn OFF the instrument and allow it to cool down for 10 minutes at least.
2. Remove all connections of pneumatic pipe, power cables and communication cables from the instrument.
3. If the instrument is wall mounted, remove it from the wall mount bracket.
4. Make sure all the 4 pneumatic ports are blocked using the supplied caps and plugs. This will prevent insects from making a home inside the cell.

Figure 25 – Pneumatic Ports Plugged and Capped

5. Place the instrument back into a plastic bag with desiccant packs and seal the bag (ideally the bag supplied upon delivery).
6. Place the instrument back into the original foam and box it was delivered in. If this is no longer available find some equivalent packaging that provides protection from damage.
7. Make sure any accessories supplied with the instrument such as the power supply, are kept in the box as well so that nothing is lost.

Note: Acoem Australasia recommends to use the same packing material in which instrument is delivered.

8. The instrument is now ready for long term storage or transportation.

3. Operation

3.1 Warm-Up

When the instrument is first turned ON it must go through a short period of adjustments and warmup. No measurements are taken during this warm-up period.

The following activities occur during warm-up:

Electronics Initialisation

On power up then main microcontroller will establish communications with the main hardware components such as the light source, sensors, LCD and converters to check that they are functioning.

Sample Flow

The sample pump speed will slowly increase until the desired sample flow setpoint is reached.

PMT Cooler

The PMT cooler supply will increase until the cooler temperature reaches its set point or its maximum output.

Sample Heater

If enabled, the sample heater will begin heating the sample until the desired temperature or RH setpoint is reached. This will take a number of minutes. The beginning of the measurement process is not dependant on it.

Reference Shutter

On warm up the reference shutter will be enabled and the LEDs will be pulsed so that an initial reference shutter count can be made as well as allowing the LEDs to warm up.

3.2 Measurement

The Aurora NE Series Multi Wavelength Nephelometers will continually cycle through a sequence of measurements to provide the parameters to calculate the final measurements.

Instrument State	Duration (seconds)	Description
Move Reference shutter into Position.		
Pulse RED LED	300 ms	Measure RED Shutter Count
Pulse GREEN LED	300 ms	Measure GREEN Shutter Count
Pulse BLUE LED	300 ms	Measure BLUE Shutter Count
Repeat x times		

Instrument State	Duration (seconds)	Description
Move Reference shutter out of Position.		
Backscatter shutter at 0 position.		
Dark Count	100 ms	Record Dark Count
Pulse RED LED	300 ms	Record RED Measure Count
Pulse GREEN LED	300 ms	Record GREEN Measure Count
Pulse BLUE LED	300 ms	Record BLUE Measure Count
Move Backscatter shutter to next angle position.		
Pulse RED LED	300 ms	Record RED Measure Count
Pulse GREEN LED	300 ms	Record GREEN Measure Count
Pulse BLUE LED	300 ms	Record BLUE Measure Count
Repeat for each backscatter angle position selected between 0 and 90 degrees.		
Repeat n times		
Move Reference shutter into Position……		

3.3 General Operation Information

The primary interaction with the instrument is through the colour touch screen on the front panel. This interface allows the user to changes settings, obtain readings, view diagnostics and perform calibrations.

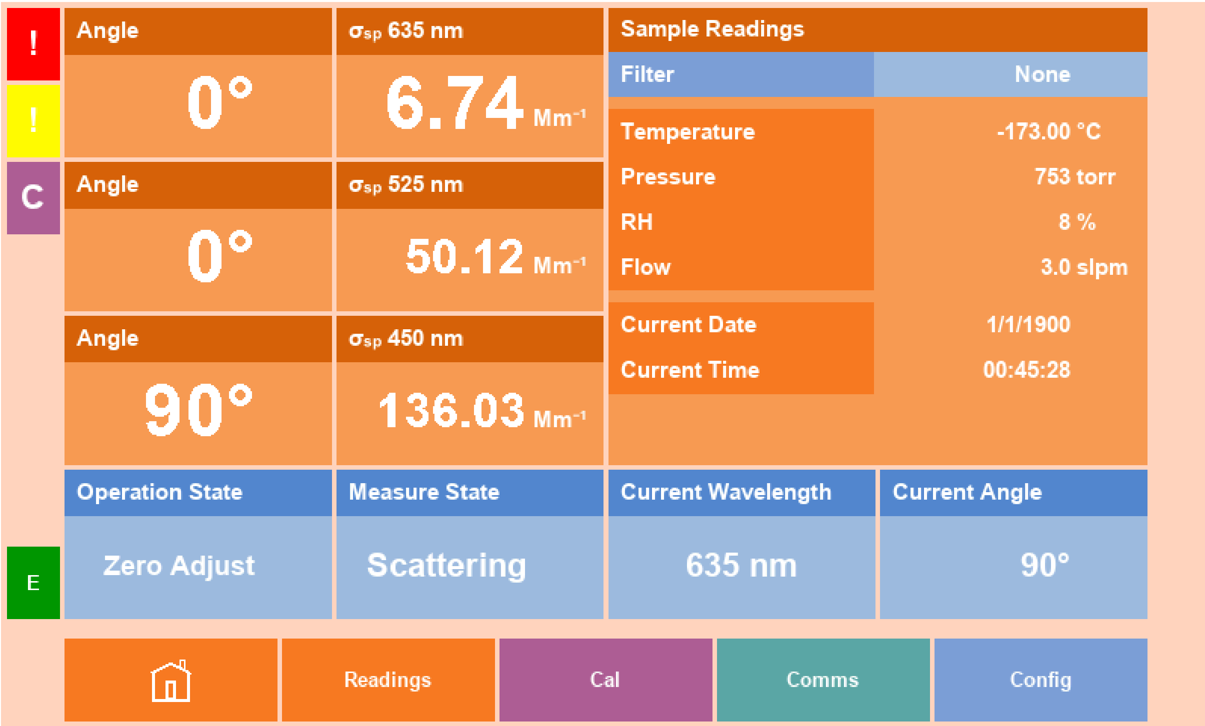


Figure 26 – Example - Colour Touch Screen for an Aurora NE-400

The user interface is designed to be interactive. Learning a few underlying concepts will make it much easier to navigate.

3.3.1 Objects

There are several kinds of objects used on the screen. Objects are generally only visible when they make sense; for instance, the alert on the left side of the screen that indicates the calibration mode only appears when the instrument is in a calibration mode.

Table 4 – List of Screen Objects

Object Name	Object Description
Fields	Display a number or text string
Buttons	Perform an action
Switches	A simple on-off button that shows its current state (green for on, red for off)
Alerts	An alert
Panels	A list of fields and buttons with a scroll bar to reveal more items

Object Name	Object Description
Menus	Pop-up menus
Dialogs	Pop-up dialog boxes
Single Field Widget	Display a number or text string within its own panel
Keypad	

3.3.2 Pages

Each screen is a page, with a name and a unifying concept. Pages are coloured according to their general area of concern.

The general screen layout has a row of navigation buttons across the bottom, and a column of alerts on the left-hand edge.

The rest of the page will be dedicated to showing information. Usually this consists of one or more fields and panels.

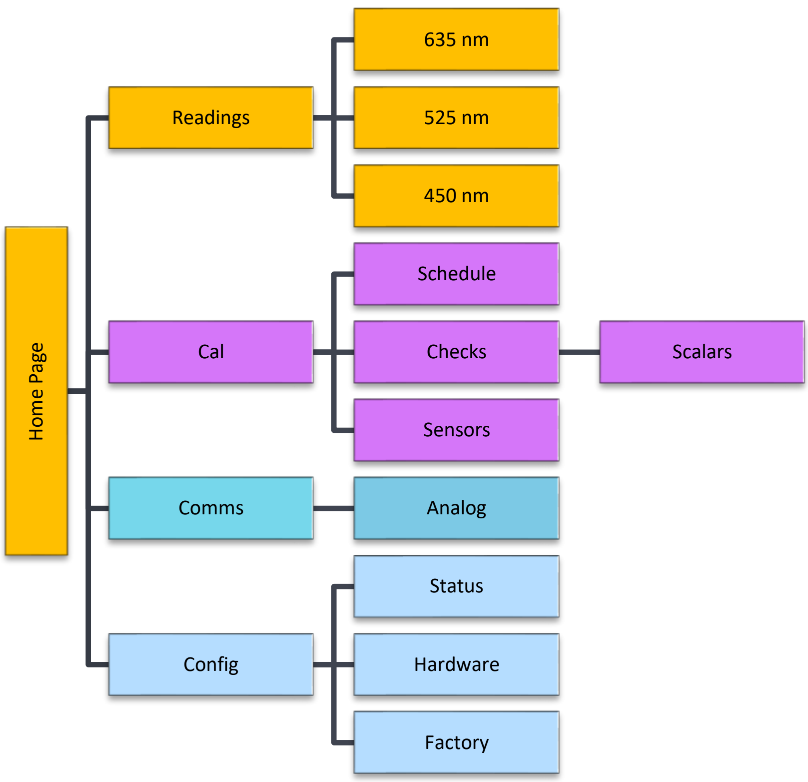


Figure 27 – Page Structure

3.3.2.1 Navigation buttons

Each button shows the name of the page it will open. Once a page is opened, the navigation row will show its child pages, if this page has any; otherwise, it will show its siblings.

The current selected page button will be the same colour as the background; touching the button again will move back up one page. The Home page button is always the first button. However, you can also touch and hold any navigation button to open a menu showing your current location and use that to go to any higher or lower page.

3.3.2.2 Alerts

The alert system along the left side of the screen is intended to make you aware of certain events. Generally speaking, any of these buttons will open a dialog box that has more detail. Once the event is resolved the alert will disappear.

Table 5 – List of Alerts

Alert Name	Alert Description
E	An event has occurred, such as the user changing a system parameter.
!	There is a current error
!	There is a current warning
C	The system is currently in a calibration state

3.3.3 Interactions

The user interface operates off of two general concepts, touch and hold. Those objects that you can interact with may use one or both of these methods, depending on what they need to do.

3.3.3.1 Touch

Touching an object on the screen will usually activate its primary purpose. For buttons, this does the action associated with the button; for switches it will change the state of the switch; for fields it will often allow you to edit the object by entering a new number or making a selection from a list.

3.3.3.2 Hold

Holding the touch for half a second will bring up the secondary interactions with the object. This almost always means opening a menu.

3.4 Pages, Menus & Panels

3.4.1 Home Page

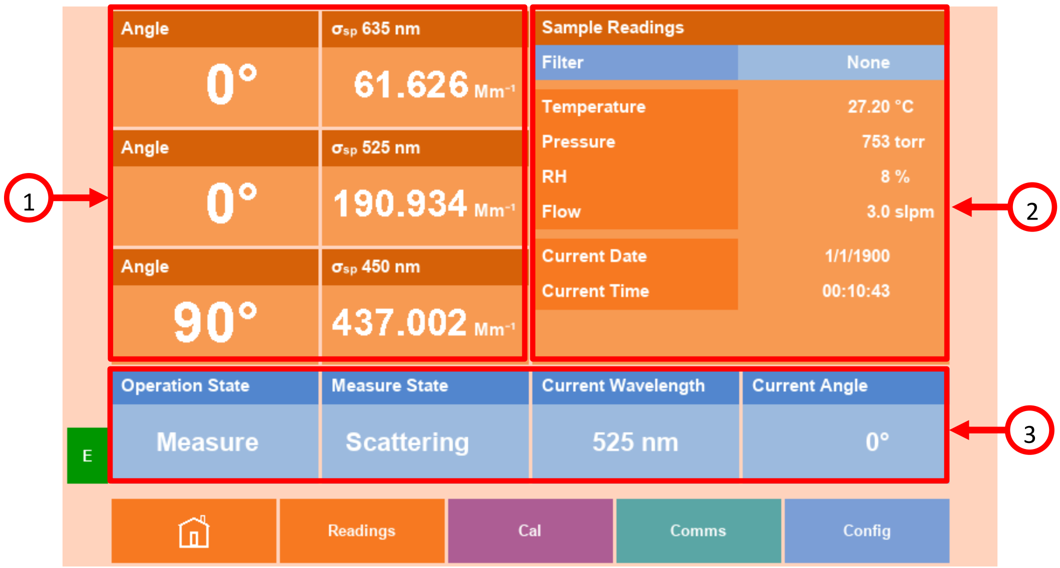


Figure 28 – Home Page

The home page for the Aurora NE Series is divided into three areas; current readings (1), sample readings (2) and instrument state (3)

3.4.1.1 Current Readings

The current angle for each wavelength is displayed, followed by the sigma for that angle. The angle values will cycle through all the measured angles as they are taken. Each angle and sigma are presented in a single field widget.

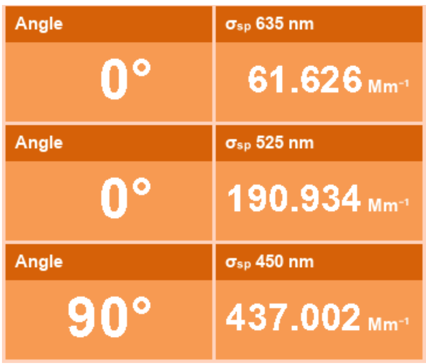


Figure 29 – Current Reading Single Field Widgets

Note: If you use the press and hold method on any of the three sigma widgets you will get a pop-up menu that allows you to change the decimal places for all sigma values.

3.4.1.2 Sample Readings

Some basic information is presented in this panel represented by the following fields:

- The filter applied to the displayed readings
- The current sample temperature, pressure, RH, and flow
- The current date and time

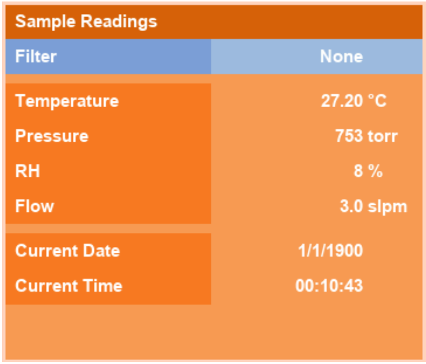


Figure 30 – Sample Readings Panel

Note: The filter can be changed at any time; the Aurora calculates all of the filtered values (None, Kalman, 1 minute, 5 minute, and Rolling Average) for every measurement. The filter selection merely controls which one is displayed.

3.4.1.3 State

The blue single field widgets at the bottom indicate the current state of the measurement:

- Operation Measure mode or a calibration operation
- Measure Reference, dark count or scattering
- Wavelength Currently being measured
- Angle Currently being measured

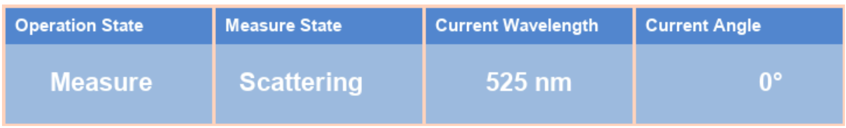


Figure 31 – State Single Field Widgets

3.4.2 Readings

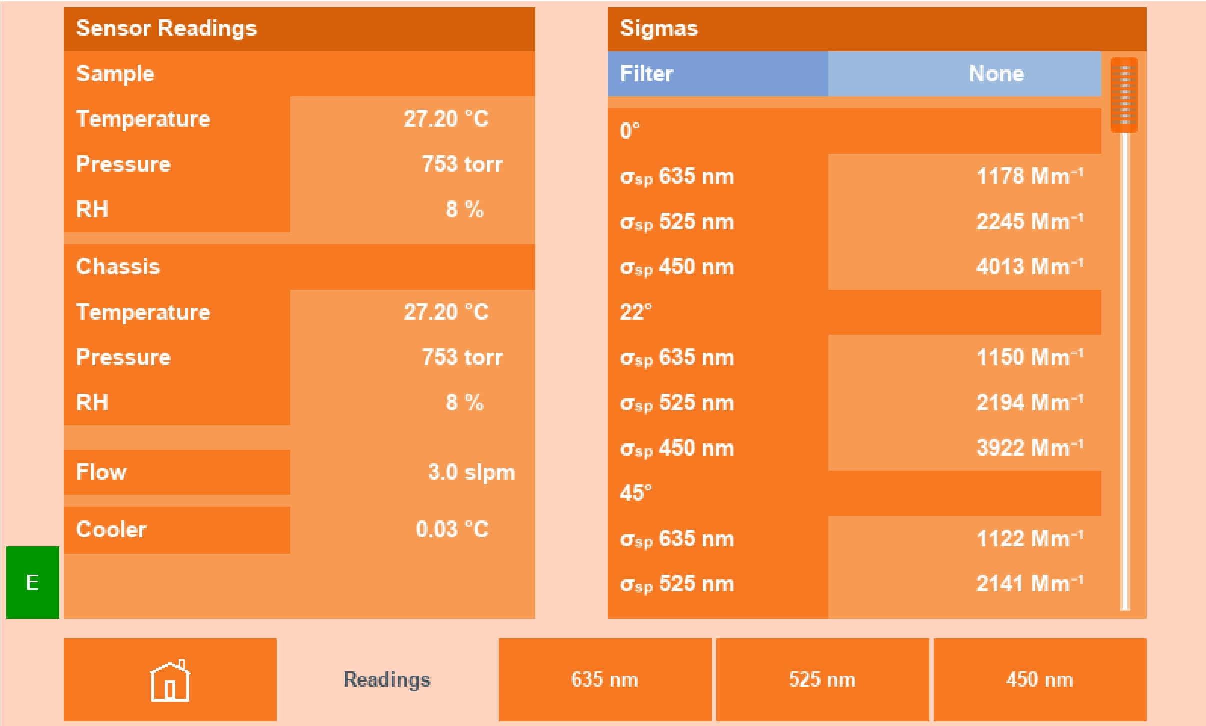


Figure 32 – Readings Page

This page shows all of the environmental and sigma readings.

Note: If the Aurora NE Series is configured to measure its full complement of three wavelengths and twenty angles, the panel on the right will be quite long. Use the scroll bar to move up and down the list.

3.4.2.1 Sensor Readings

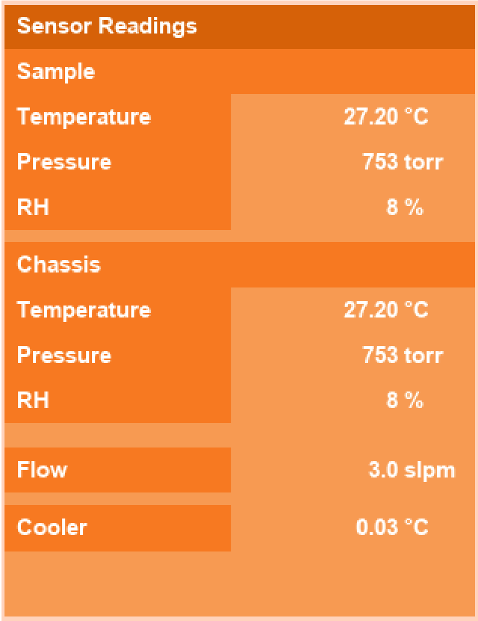


Figure 33 – Sensor Readings Panel

The environmental sensor information is presented in this panel. The information is grouped by headings and represented by the following fields:

Sample

- The current sample temperature, pressure, RH

Chassis

- The current chassis temperature, pressure, RH

- The current sample flow
- The current PMT cooler temperature

3.4.2.2 Sigmas

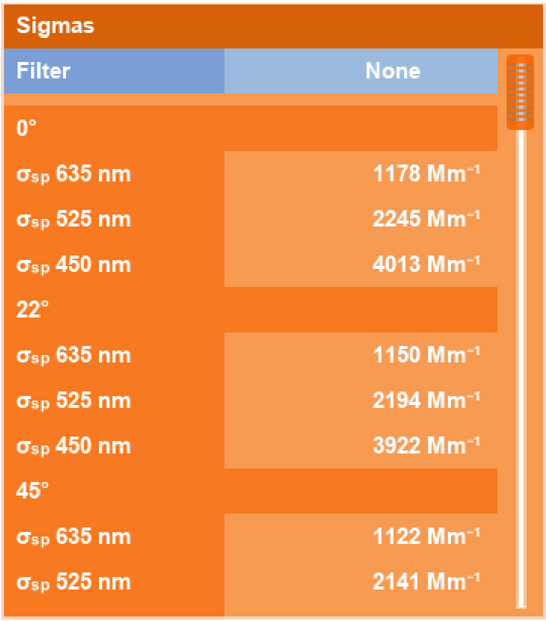


Figure 34 – Sigmas Panel

The sigmas information is presented in this panel. The information is grouped by headings pre angle and represented by the following fields:

- Filter
- Window

n°

- The current Sigma reading for 635 nm, 525 nm, 450 nm

Note: If the Aurora NE-400 is configured to measure its full complement of three wavelengths and twenty angles, this panel will be quite long. Use the scroll bar to move up and down the list.

3.4.3 635 nm/525 nm/450 nm

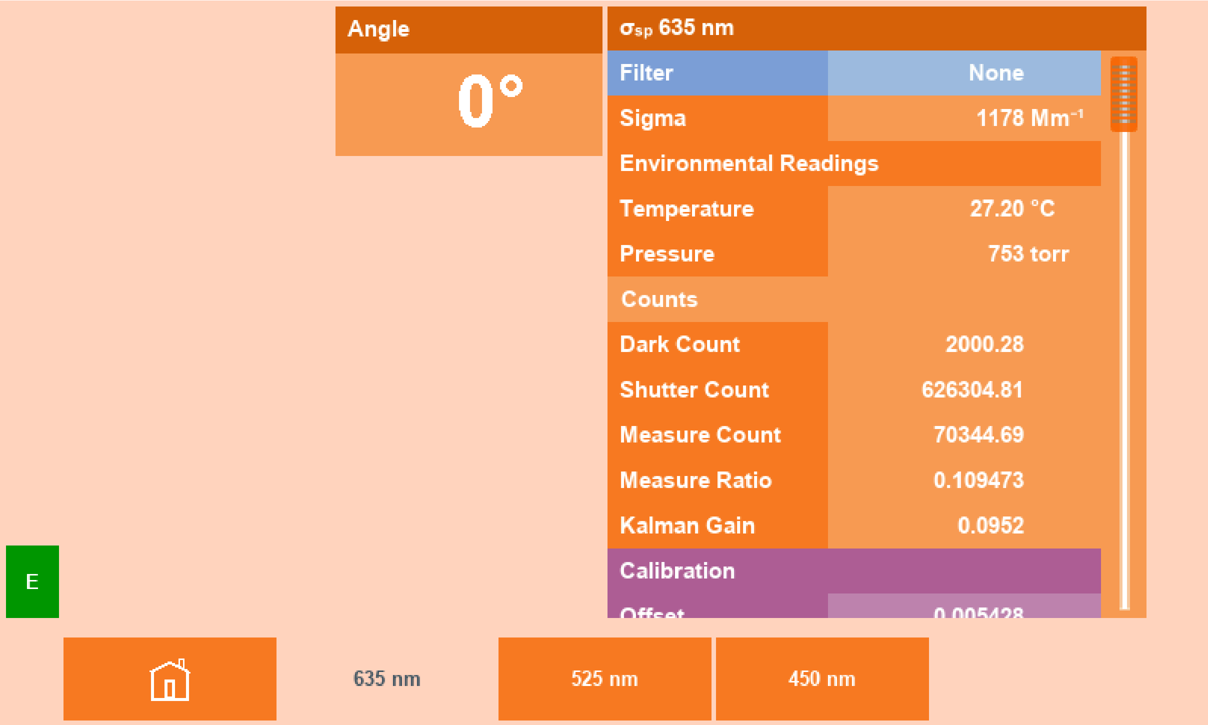


Figure 35 – 635 nm Child Page

This section covers the next three child pages, 635 nm, 525 nm and 450 nm. Each child page has a similar setup that show each set of readings in much greater detail.

The angle single field widget allows the user to select which angle's information is displayed.

The wavelength panel lists all of the numbers involved in calculating the sigma.

3.4.3.1 Angle

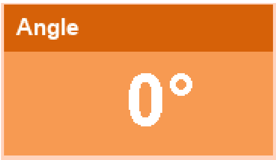


Figure 36 – Angle Single Field Widget

By touching the angle single field widget, a popup menu will appear allowing the user to select which angle's information is displayed on the wavelength panel. The number of angles that appear in the popup menu list will depend on the number of angles selected in the measurement settings panel on the cal page (refer to Section 3.4.4.1).

3.4.3.2 σ_{sp} 635 nm/525 nm/450 nm

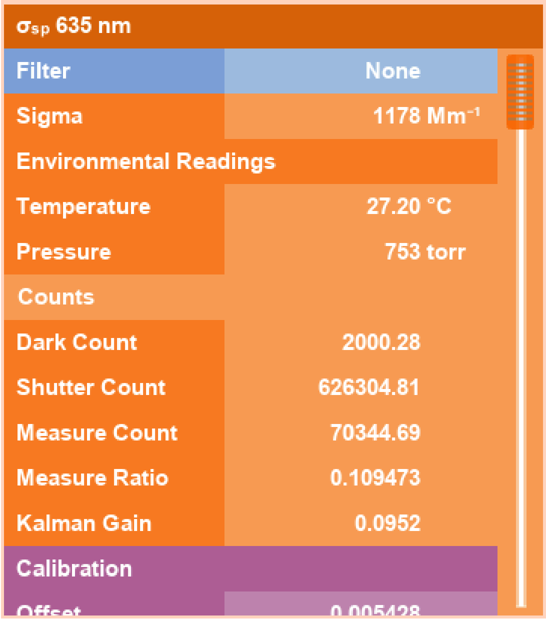


Figure 37 – σ_{sp} 635 nm

The σ_{sp} wavelength information is presented in this panel, listing all of the numbers involved in calculating the sigma. The information is grouped by headings pre angle and represented by the following fields:

- Filter
  - o Window
- Sigma

Environmental Readings

- The current temperature, pressure, dark count, shutter count, measure count, measure ratio, Kalman gain

Note: If the Aurora NE-400 is configured to measure its full complement of three wavelengths and twenty angles, this panel will be quite long. Use the scroll bar to move up and down the list.

Calibration

- Current calibration offset, slope, st correction

Config

- Current configuration for the measurement time

3.4.4 Cal

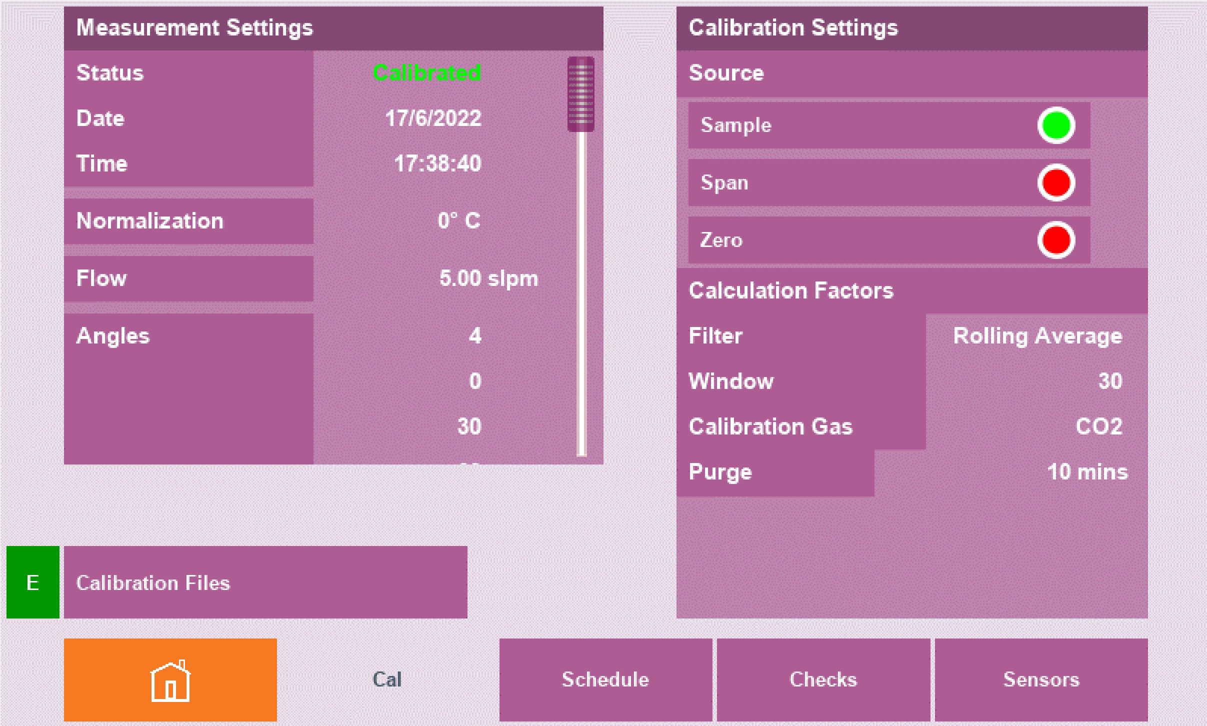


Figure 38 – Calibration Page

The cal page and child pages allow configuration of the measurement and calibration activities. This page is broken up into three main sections measurement settings panel, calibration settings panel and the calibration files button.

To schedule or perform a calibration, go to the schedule child page (refer to Section 3.4.5).

3.4.4.1 Measurement Settings

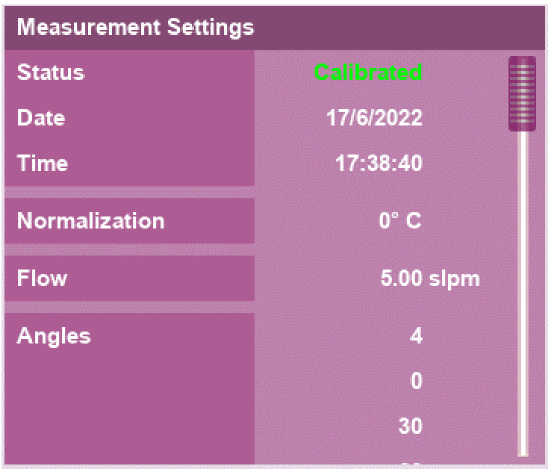


Figure 39 – Measurement Settings Panel

The measurement settings panel has information about the status of your current calibration, calibrated or uncalibrated as well as a definition the measurement setting linked to that calibration.

When the status is set to calibrated, it will indicate the date and time the calibration occurred. If any chances are made to the definition in most instances the calibration will become invalid and the status will change from calibrated to uncalibrated.

The information is represented by the following fields:

- Status
  - Date, Time
- Normalization
- Flow
- Angle

Below is a description of those fields:

The status field lets you know when the system needs to be recalibrated because relevant measurement settings have been changed. You can manually over-ride it if you are certain your calibration is still valid.

The date and time of the last valid calibration. These fields only appear when the status is set to calibrated.

The normalization temperature that was used in the calibration is shown (0, 20, or 25 °C).

The flow rate when the calibration was performed is shown.

The time periods for the measurement control the LEDs. These are factory settings and should not be changed without advice. The Dark period is measured as a reference, the Measure period is the amount of time the LED is on, and the Delay period is the additional amount of time the LED is on before photon counting commences (allowing the LED output to stabilize).

The Reference section specifies the nature of the reference measurements. Repeat References controls how many averages are in the reference measurement, and Repeat Scattering controls how many complete scattering measurements (each wavelength/angle combination) are done before the reference is recalculated.

The wavelength buttons control which wavelengths are included in the measurement. Normally all three are of interest but the Aurora can be configured to measure just one or two of the available wavelengths.

The Angle field controls how many angles are measured. This value can be from 1 to 20. Below this is the list of actual angles that will be measured, specified in degrees. It is strongly advised that the angles be in ascending order. The Assign angles from 0° to 90° button will automatically fill out the angle list for you in even increments.

When changes are made to the Measurement Settings, two buttons appear (refer to Figure 40). Selecting Cancel will revert the changes without any effect; selecting Accept will cause a popup confirmation box to appear giving the user a second chance to revert the changes; selecting Accept will stop the current measurement cycle and restart it with the new settings It will also cause the status to change to uncalibrated.

![acoem logo]

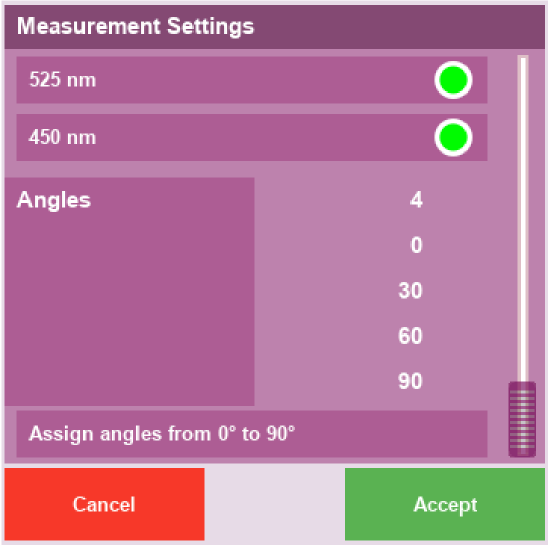


Figure 40 – Cancel and Accept Buttons for Measurement Settings Panel

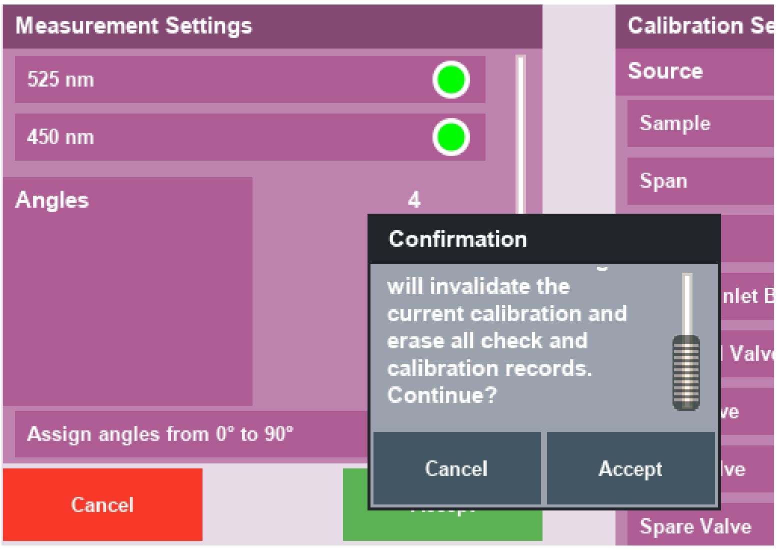


Figure 41 – Popup Confirmation Box

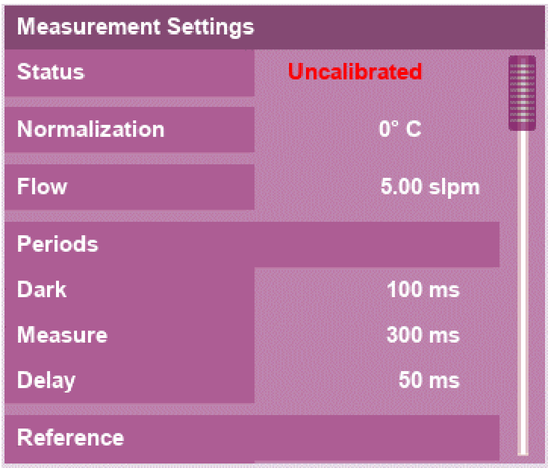


Figure 42 – Status Changing to Uncalibrated

3.4.4.2 Calibration Settings

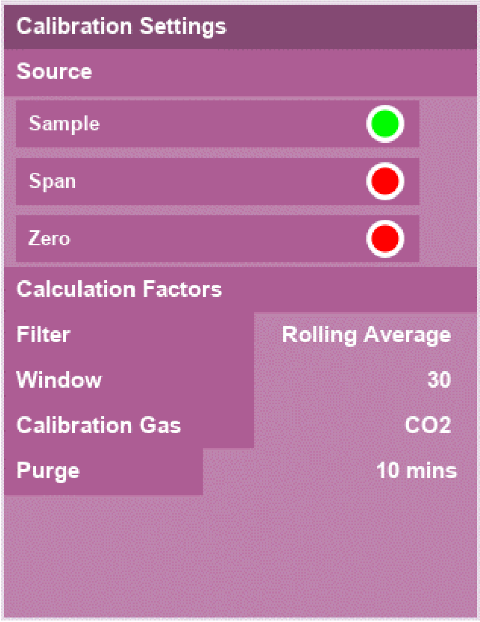


Figure 43 – Calibration Settings Panel

The calibration settings panel has information on the calibration settings.

The information is represented by the following headings and fields:

Source

- Sample, span zero

Calculation Factors

- Filter, calibration gas, purge
    - Window

Below is a description of those fields:

The source section indicates what input port the sample is being drawn from. The source can be changed manually or in response to a scheduled calibration or precision check. Scheduled calibrations will change the valves automatically, so these buttons are only for troubleshooting.

Note: Changing the valves takes approximately 5 seconds, during which time the valve switches will turn grey to indicate they are in transition.

Calculation Factors are common settings for all calibrations.

The Filter used in the calibration does not need to match the filter of the displayed data.

You must correctly identify the Calibration Gas connected to the Span port.

You may specify the amount of time that the sample cell is allowed to purge after each automatic valve change.

3.4.4.3 Calibration Files

Figure 44 – Calibration Files Button

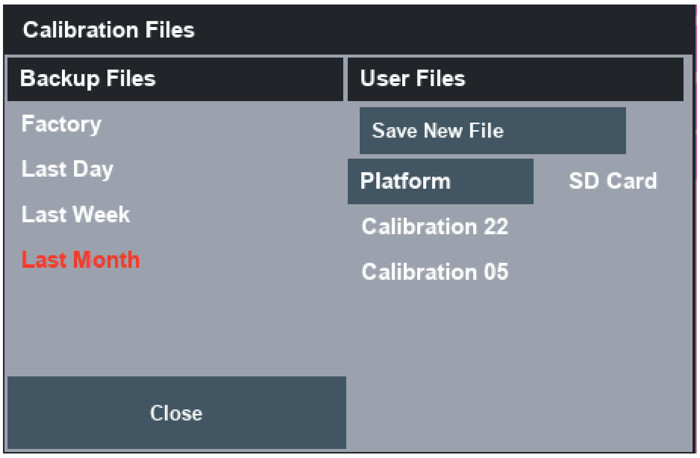


Figure 45 – Calibration Files Dialog Box

This button opens a dialog box that saves and loads calibration data. The most likely use of this feature is to support changing between the number and degree of angles measured. For instance, you might configure the Aurora to measure two angles, perform a full calibration, and then take a few minutes of measurements to verify the instrument is performing as expected. Then you might reconfigure the instrument to measure 20 angles, instruct it to recalibrate, and leave it running for a few hours.

If you saved both calibrations to named files (such as 00 and 20), you could easily switch back and forth between the two configurations for quick measurements or extended measurements.

At this time files can only be named with two numeric digits.

3.4.4.3.1 Backup Files

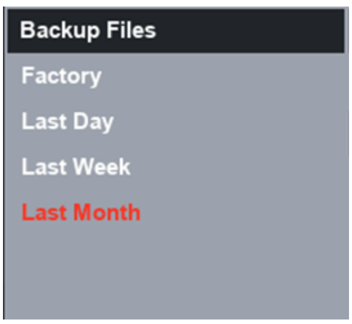


Figure 46 – Backup Files

The backup files section of the calibration files dialog box allows the user to load, a factory backup, last day, last week or last month. The factory option is a backup of the Aurora NE Series as it left the factory. The last day, last week and last month are automatic backups made by the instrument. This can be useful for troubleshooting to get you back to a known working calibration.

When you use the press and hold method on any one of the mentioned fields the field will change to a light blue background and you get an additional popup menu with the option to load or copy the file.

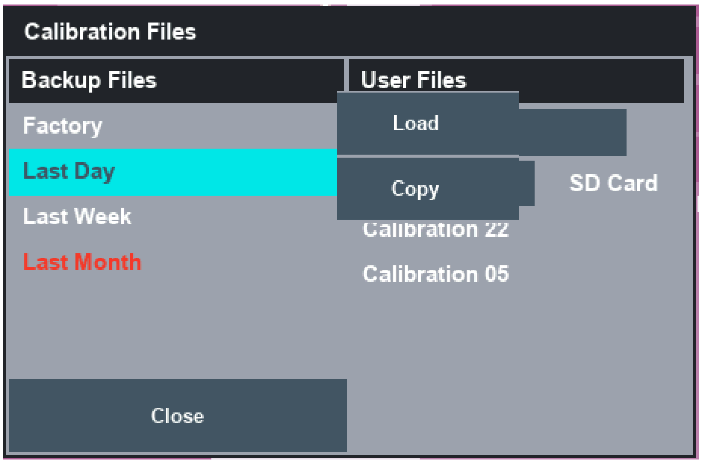


Figure 47 – Last Day Backup File Load/Copy Popup Menu

Selecting load will popup a confirmation dialog box with information about the configuration file (refer to Figure 48). Selecting Accept on the confirmation dialog box will proceed to load the calibration.

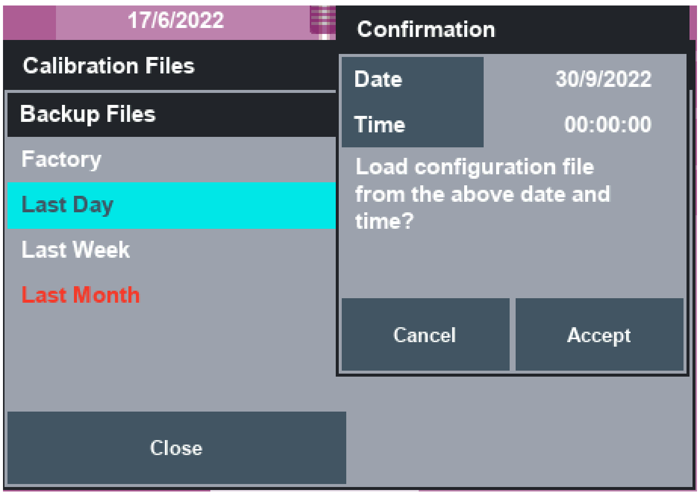


Figure 48 – Last Day Backup File Load Confirmation Dialog Box

Selecting copy will copy the file to the USB.

3.4.4.3.2 User Files

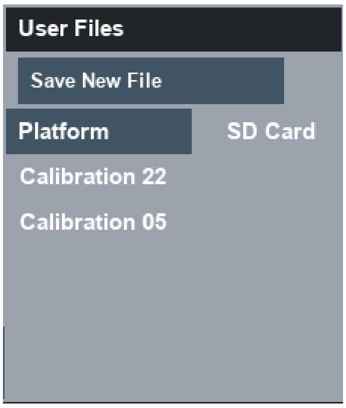


Figure 49 – User Files

The user files section of the calibration files dialog box we have a button to save new calibration file configurations, we have a field labelled platform that allows the user to select where the files are stored and under that we have a running list of calibration saves the user has manually made using the save new file button.

To save a new calibration configuration press the save new file button. This will popup a save dialog box.

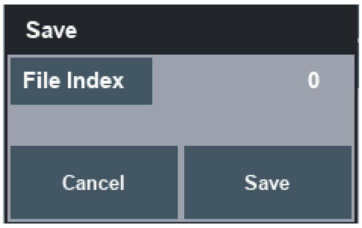


Figure 50 – Save Dialog Box

Using the touch method on the file index will bring up the keypad. Using the keypad type in the number for the calibration save form 0 – 99, then press the return key (refer to Section **Error! Reference source not found.** for keypad operation).

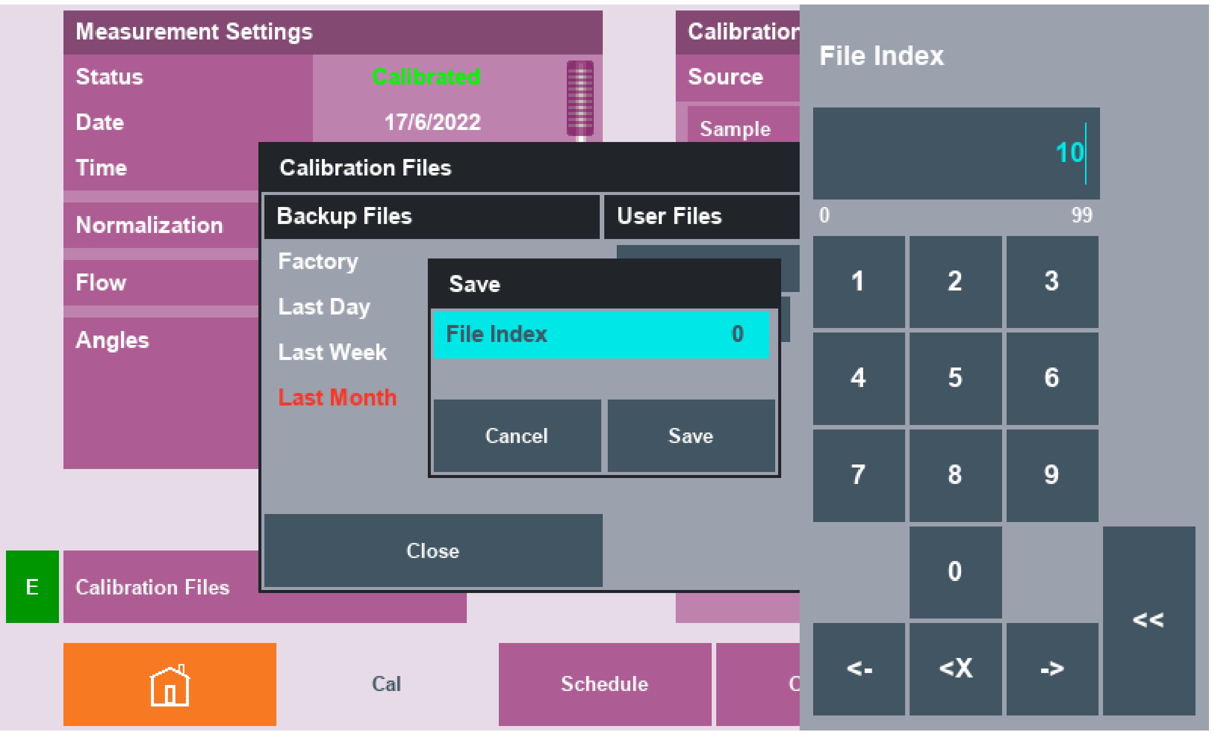


Figure 51 – Changing File Index From 0 to 10

After the save button is pressed a new calibration save is created and added to the end of the list.

Note: New configuration saves are added to the end of the list and are displayed in the order they were saved, not in ascending or descending order.

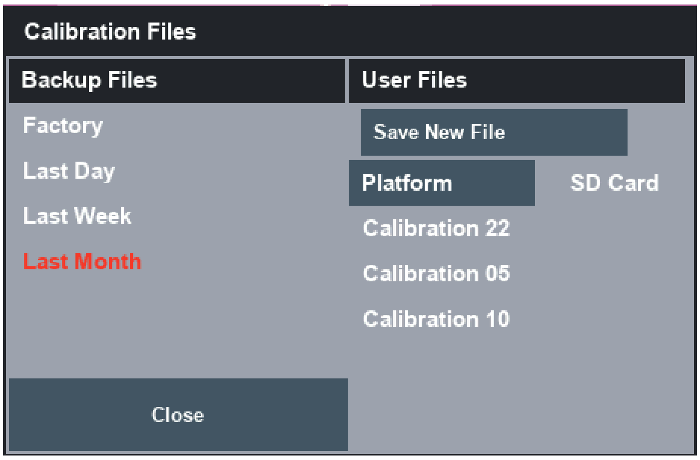


Figure 52 – New Calibration Configuration Save

Note: The user can have a total of 100 calibration saves as the list increases the dialog box will be quite long. Use the scroll bar to move up and down the list.

3.4.5 Schedule

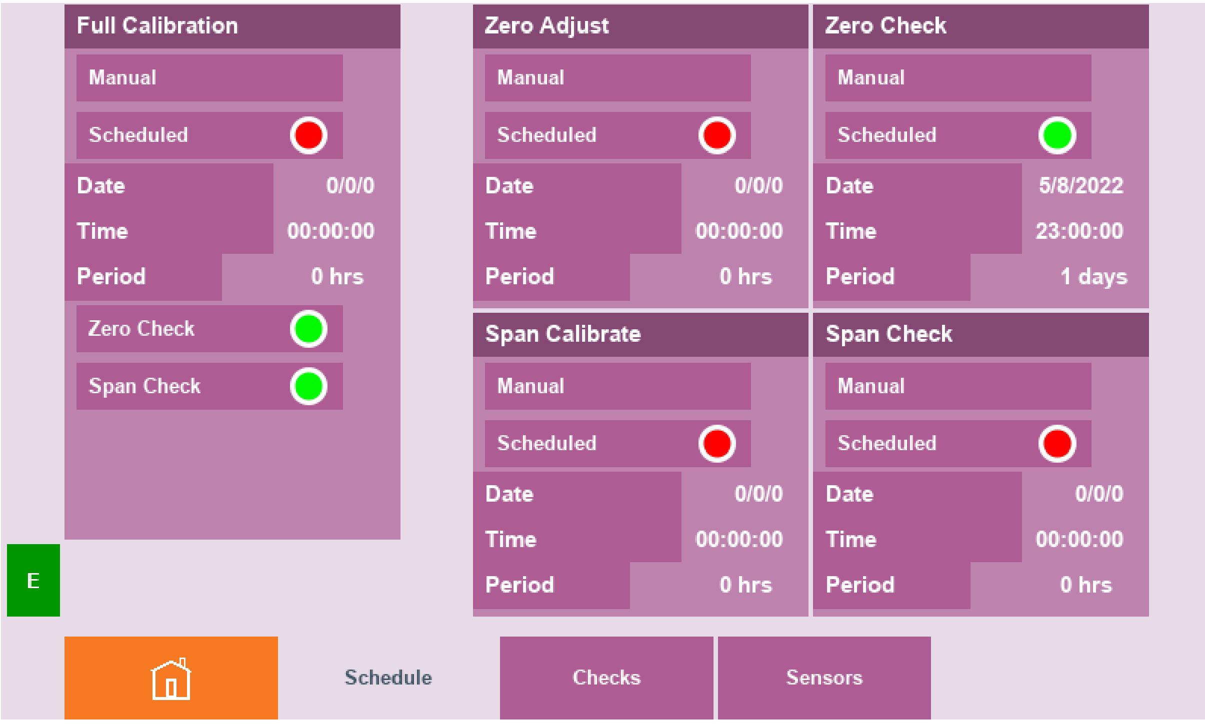


Figure 53 – Calibration Schedule Child Page

The schedule child page allows for scheduling of calibrations and precision checks. This child page is broken up into 5 panels, full calibration, zero adjust, zero check, span calibrate and span check.

Note: The date and time on each panel are when the next scheduled calibration will occur. To see calibrations that have already been done, go to the checks child page (refer to Section 3.4.6).

Calibrations or checks can either be triggered immediately with the manual button or scheduled for a later date. Specifying a period will repeat the calibration at regular intervals.

3.4.5.1 Full Calibration

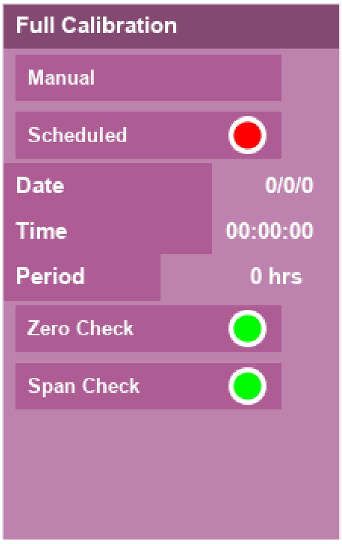


Figure 54 – Full Calibration Panel

A full calibration does both zero adjust and span calibrate, with optional checks after each stage.

Note: If a field with a radio button is red, it is disabled. If it is green, it is enabled. Touching the radio button will alternate its state.

Pressing the manual button will bring up a confirmation dialog box

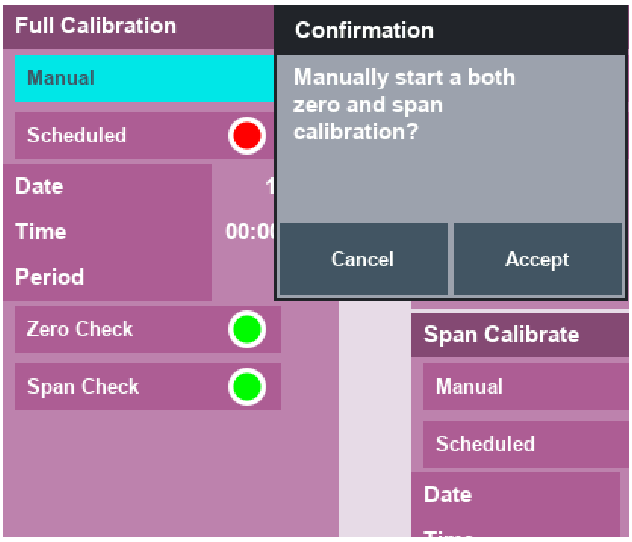


Figure 55 – Manual Full Calibration Confirmation Dialog Box

Selecting Cancel will revert the calibration without any effect; selecting Accept will proceed to start the calibration sequence. When the calibration sequence is started the calibration alert icon will appear on the left of the page.

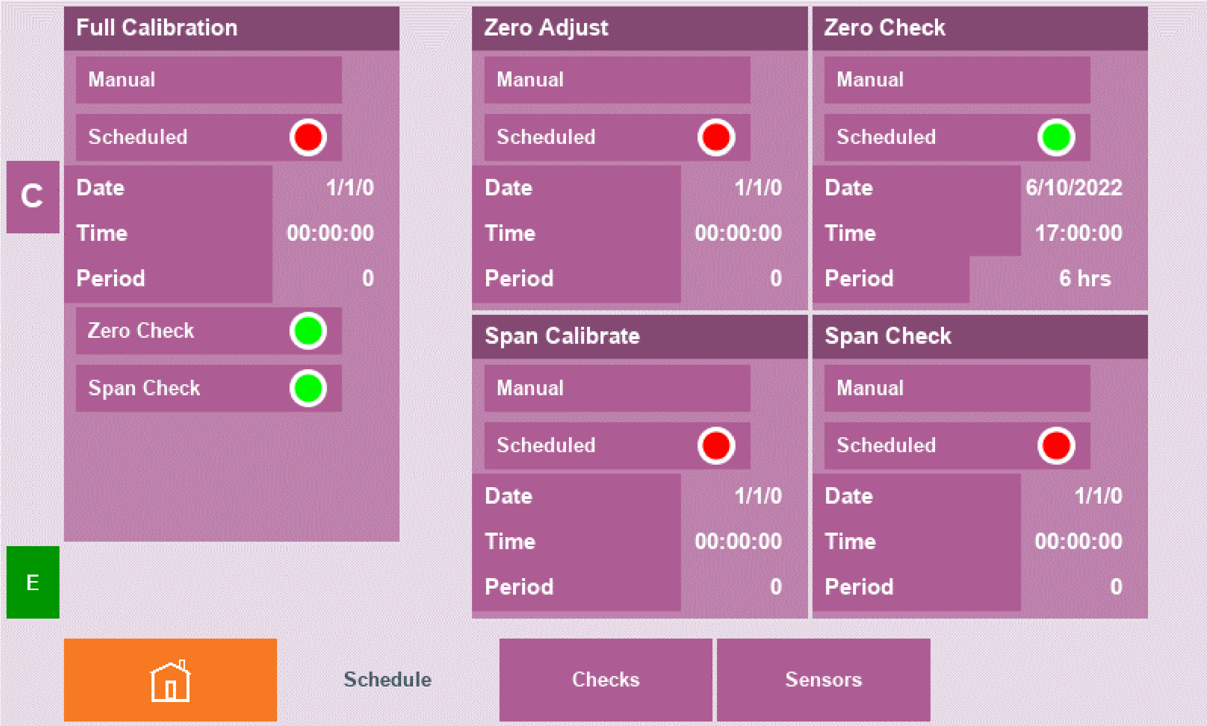


Figure 56 – Manually Started Full Calibration

Pressing the calibration alert will popup a manual calibration dialog box. The dialog box presents the current task, state of the task and time remaining of the task in seconds. It also has a stop calibration button.

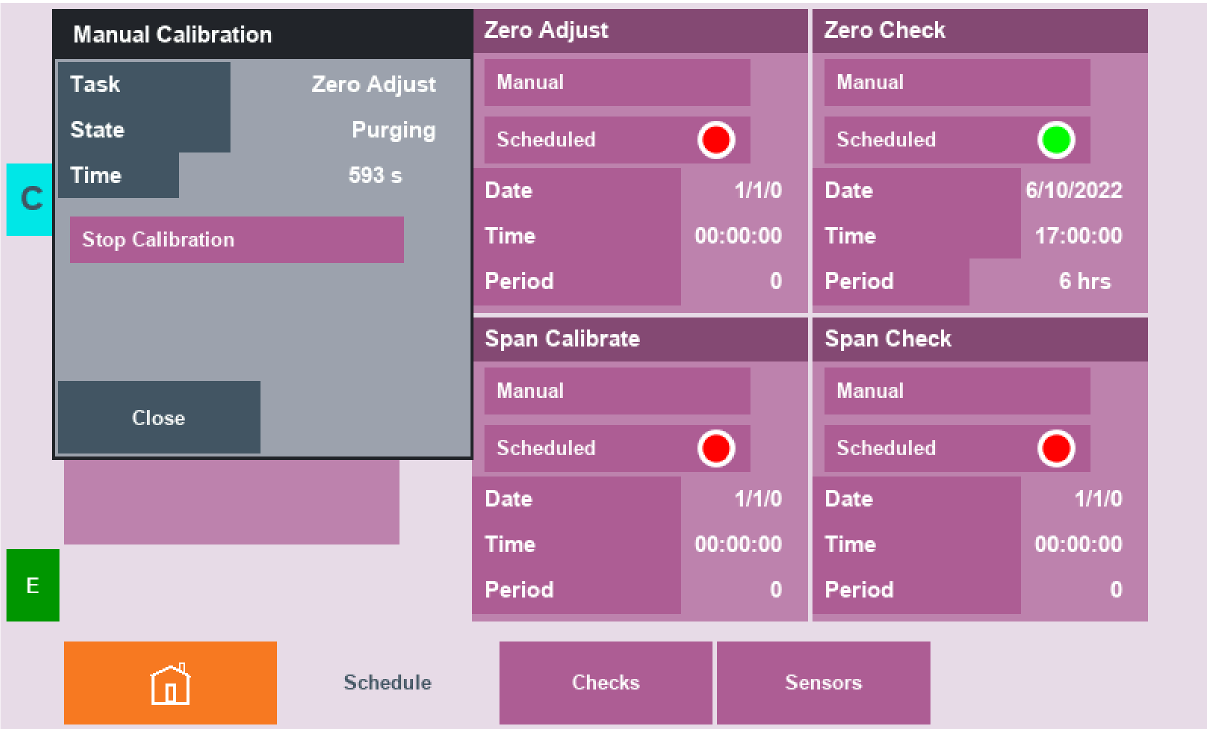


Figure 57 – Manual Calibration Dialog Box

Pressing the stop calibration button will popup a confirmation dialog box, selecting cancel will close the dialog box and continue with the calibration, selecting accept will change source valves back to sample and change the state to complete and run a purge.

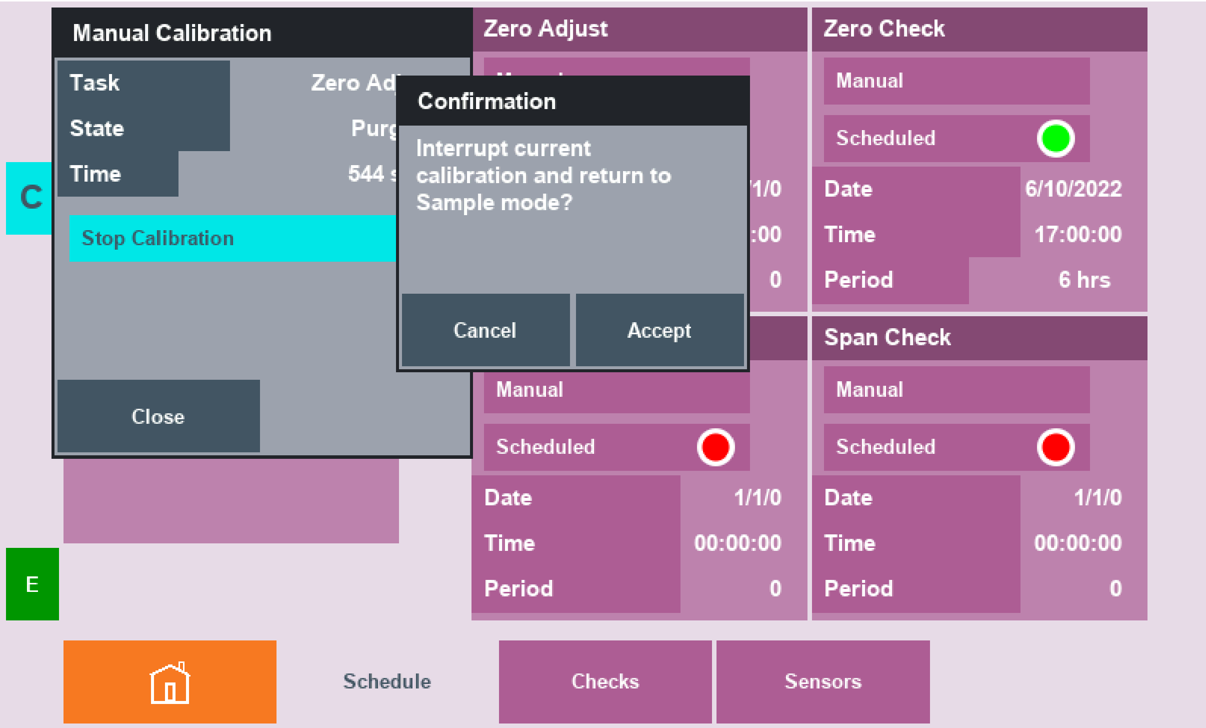


Figure 58 – Stop Calibration Confirmation Dialog Box

Note: Pressing stop calibration again will override the purge state and completely stop the calibration.

3.4.5.2 Zero Adjust

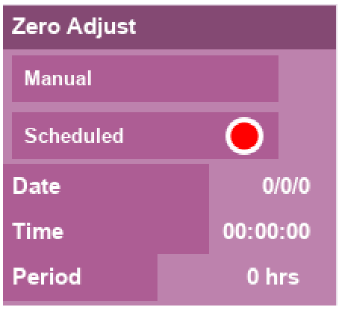


Figure 59 – Zero Adjust Panel

This panel is used to schedule or manually perform a zero calibration.

Note: If a field with a radio button is red, it is disabled. If it is green, it is enabled. Touching the radio button will alternate its state.

Pressing the manual button will bring up a confirmation dialog box

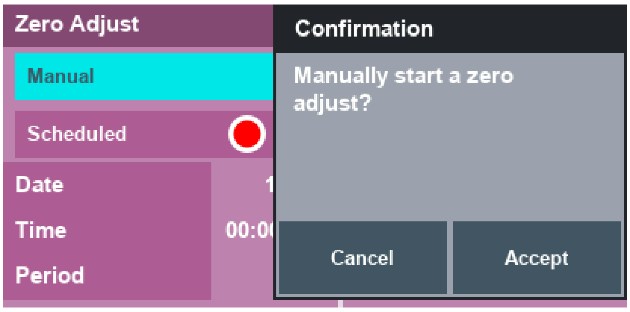


Figure 60 – Manual Zero Adjust Confirmation Dialog Box

Selecting Cancel will revert the calibration without any effect; selecting Accept will proceed to start the calibration sequence. When the calibration sequence is started the calibration alert icon will appear on the left of the page.

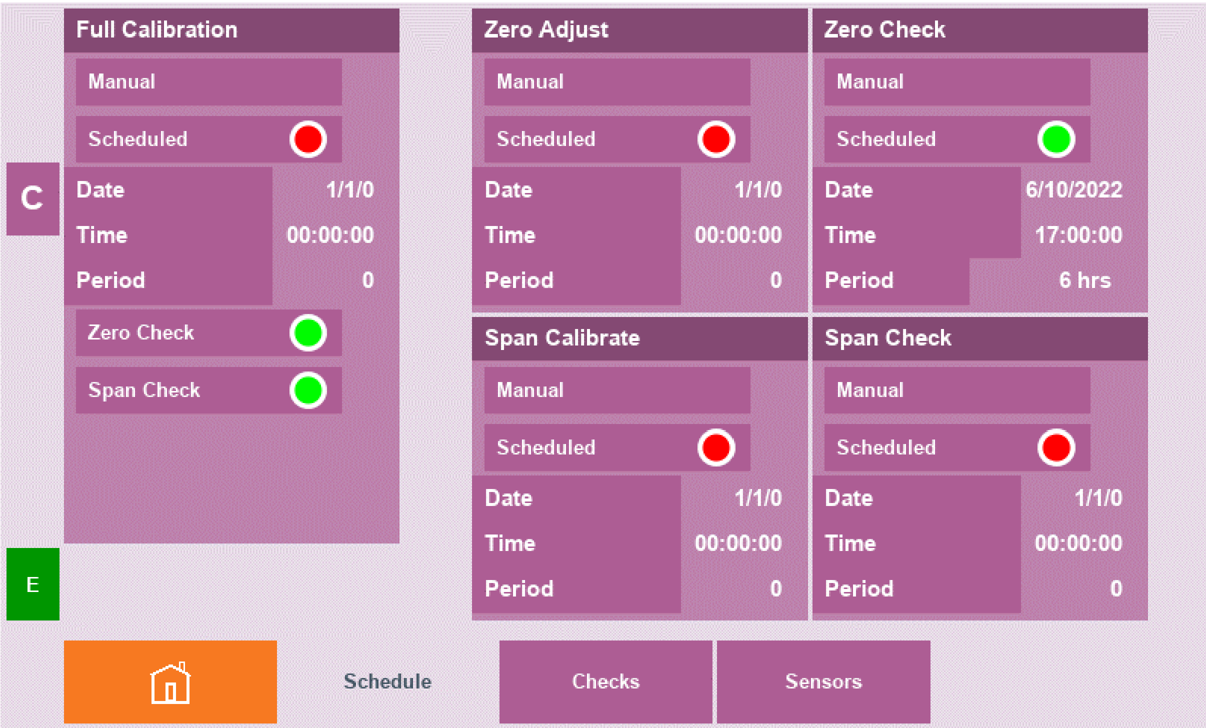


Figure 61 – Manually Started Zero Adjust

Pressing the calibration alert will popup a manual zero adjust dialog box. The dialog box presents the current state and time remaining in seconds. It also has a stop calibration button.

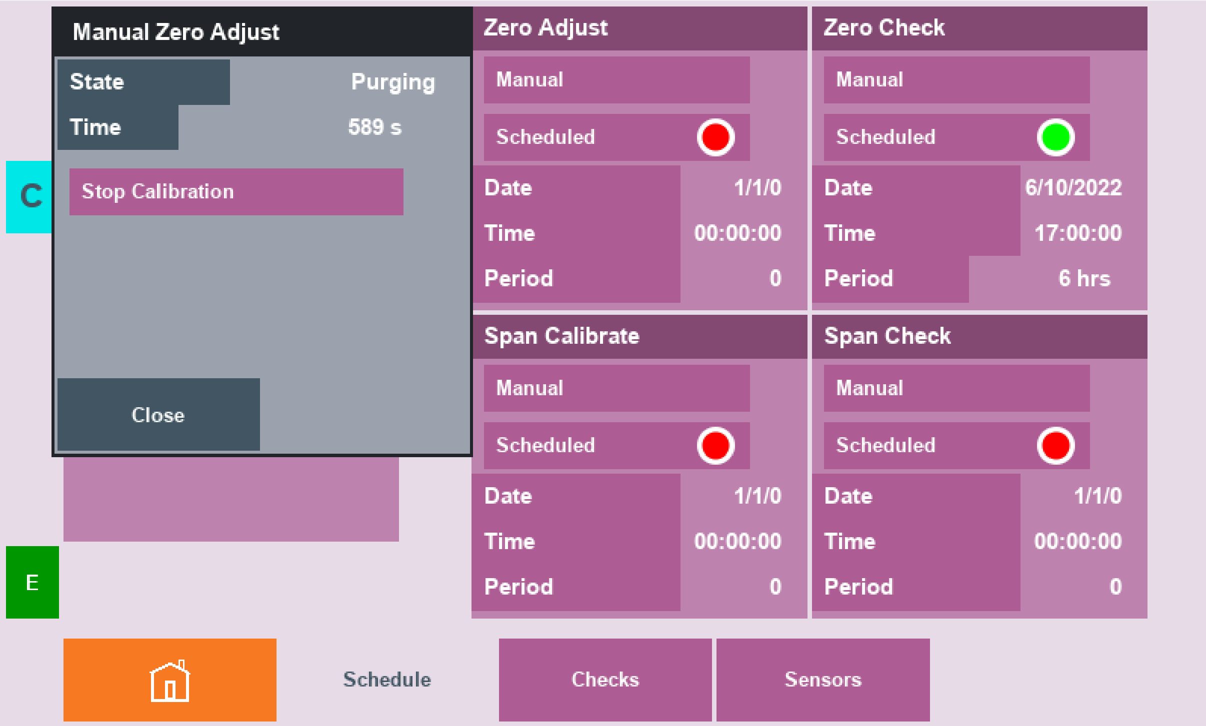


Figure 62 – Manual Zero Adjust Dialog Box

Pressing the stop calibration button will popup a confirmation dialog box, selecting cancel will close the dialog box and continue with the calibration, selecting accept will change source valves back to sample and change the state to complete and run a purge.

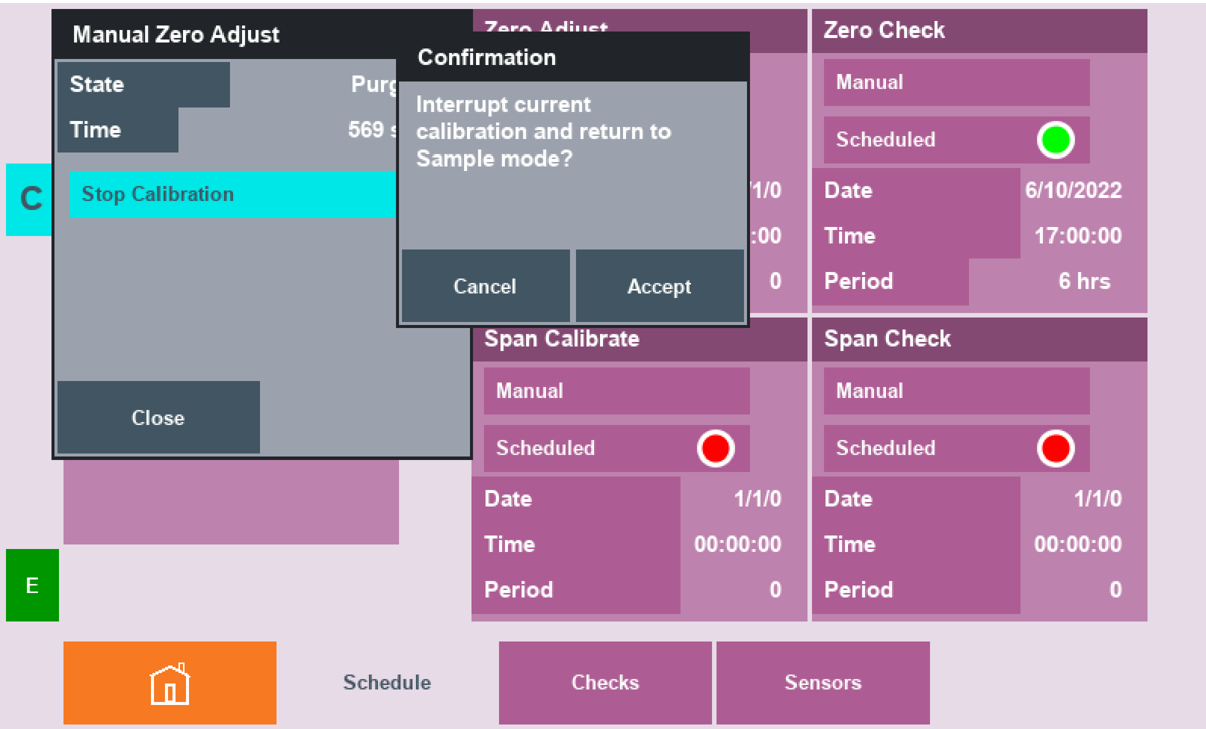


Figure 63 – Stop Calibration Confirmation Dialog Box

Note: Pressing stop calibration again will override the purge state and completely stop the calibration.

3.4.5.3 Zero Check

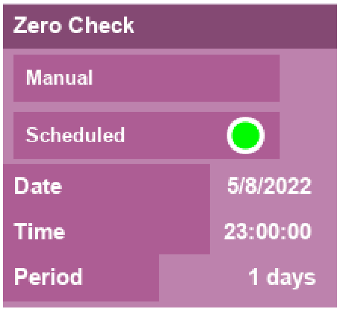


Figure 64 – Zero Check Panel

This panel is used to schedule or manually perform a zero check. A check switches to the zero source and does a full measurement cycle, but does not change the calibration.

Note: If a field with a radio button is red, it is disabled. If it is green, it is enabled. Touching the radio button will alternate its state.

Pressing the manual button will bring up a confirmation dialog box

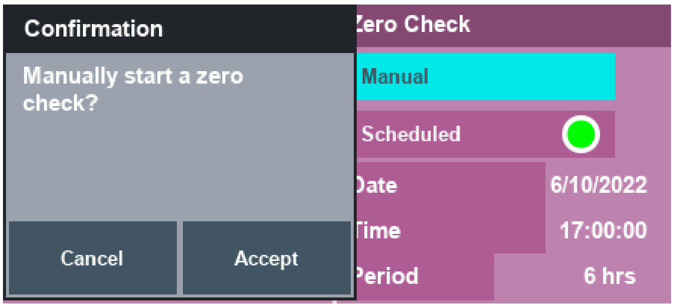


Figure 65 – Manual Zero Check Confirmation Dialog Box

Selecting Cancel will revert the calibration without any effect; selecting Accept will proceed to start the calibration sequence. When the calibration sequence is started the calibration alert icon will appear on the left of the page.

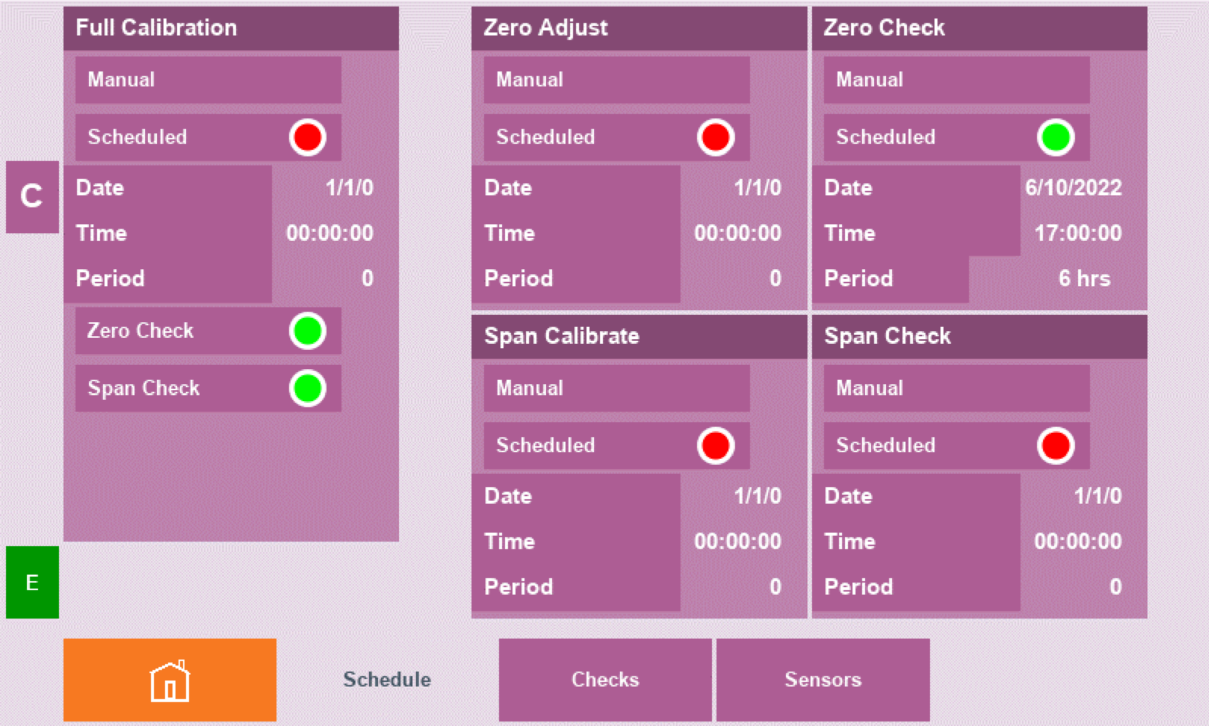


Figure 66 – Manually Started Zero Check

Pressing the calibration alert will popup a manual zero check dialog box. The dialog box presents the current state and time remaining in seconds. It also has a stop calibration button.

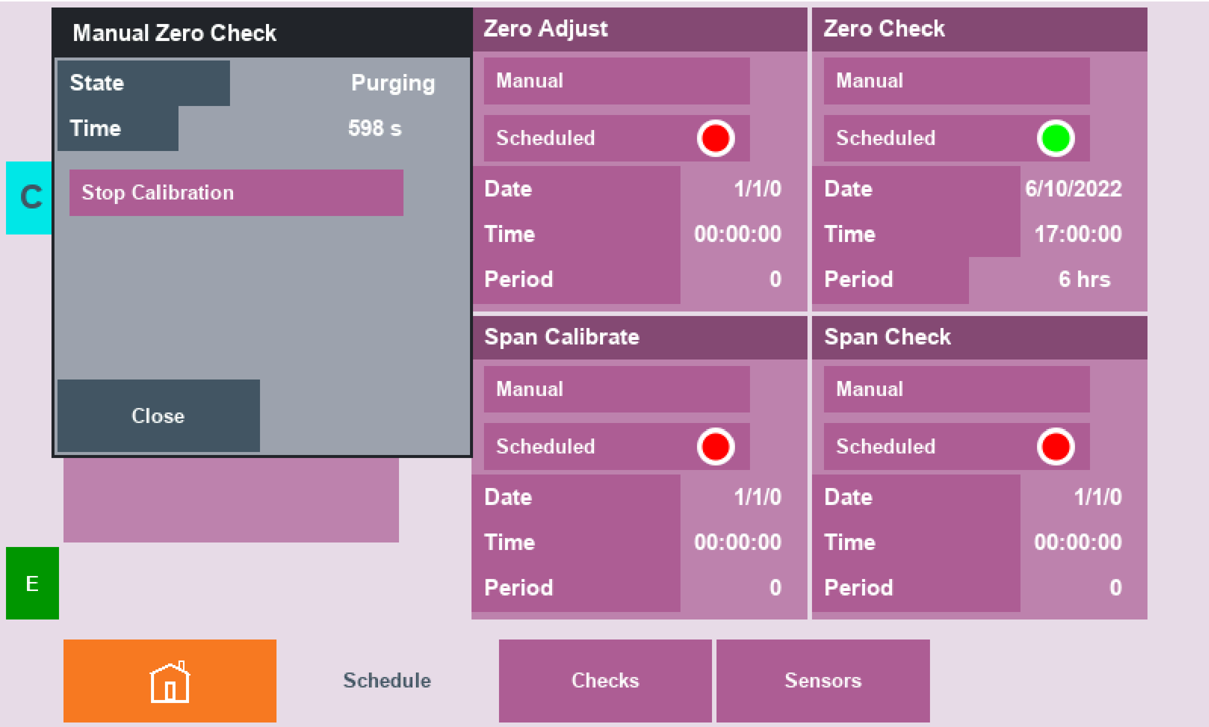


Figure 67 – Manual Zero Check Dialog Box

Pressing the stop calibration button will popup a confirmation dialog box, selecting cancel will close the dialog box and continue with the calibration, selecting accept will change source valves back to sample and change the state to complete and run a purge.

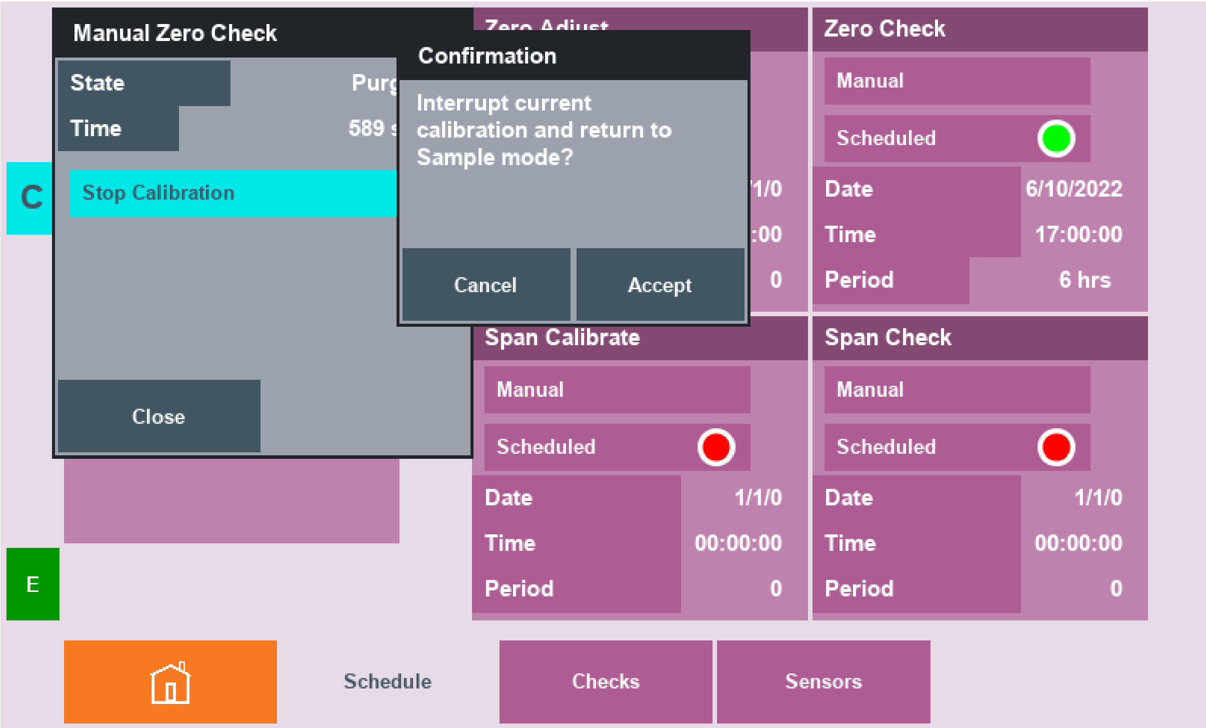


Figure 68 – Stop Calibration Confirmation Dialog Box

Note: Pressing stop calibration again will override the purge state and completely stop the calibration.

3.4.5.4 Span Calibrate

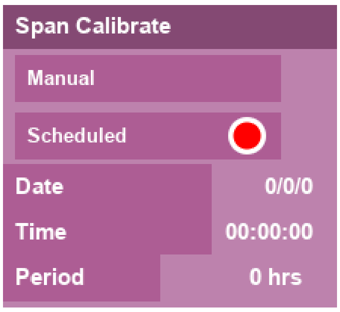


Figure 69 – Span Calibrate Panel

This panel is used to schedule or perform a span calibration.

Note: If a field with a radio button is red, it is disabled. If it is green, it is enabled. Touching the radio button will alternate its state.

Pressing the manual button will bring up a confirmation dialog box

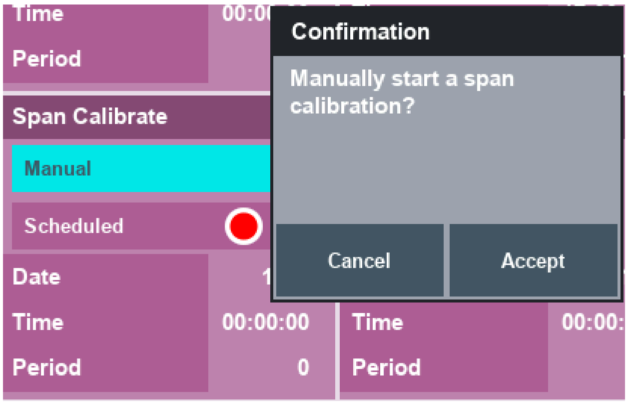


Figure 70 – Manual Span Calibrate Confirmation Dialog Box

Selecting Cancel will revert the calibration without any effect; selecting Accept will proceed to start the calibration sequence. When the calibration sequence is started the calibration alert icon will appear on the left of the page.

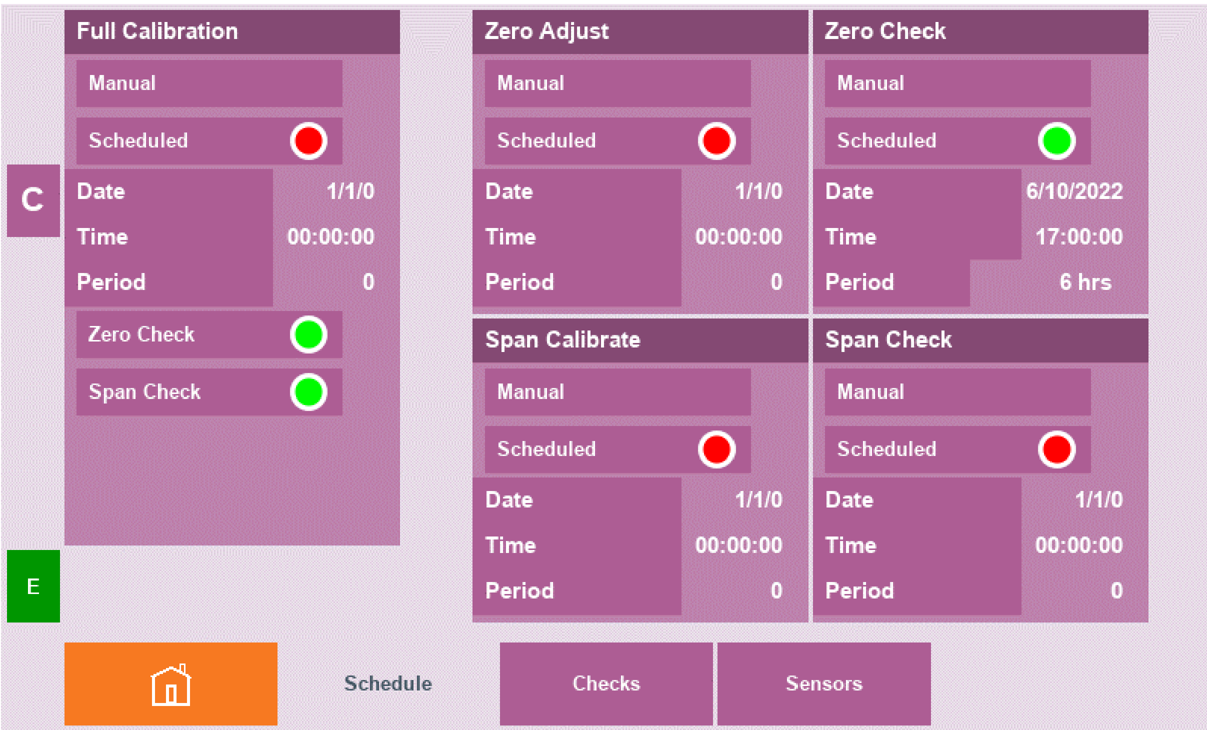


Figure 71 – Manually Started Span Calibrate

Pressing the calibration alert will popup a manual span calibrate dialog box. The dialog box presents the current state and time remaining in seconds. It also has a stop calibration button.

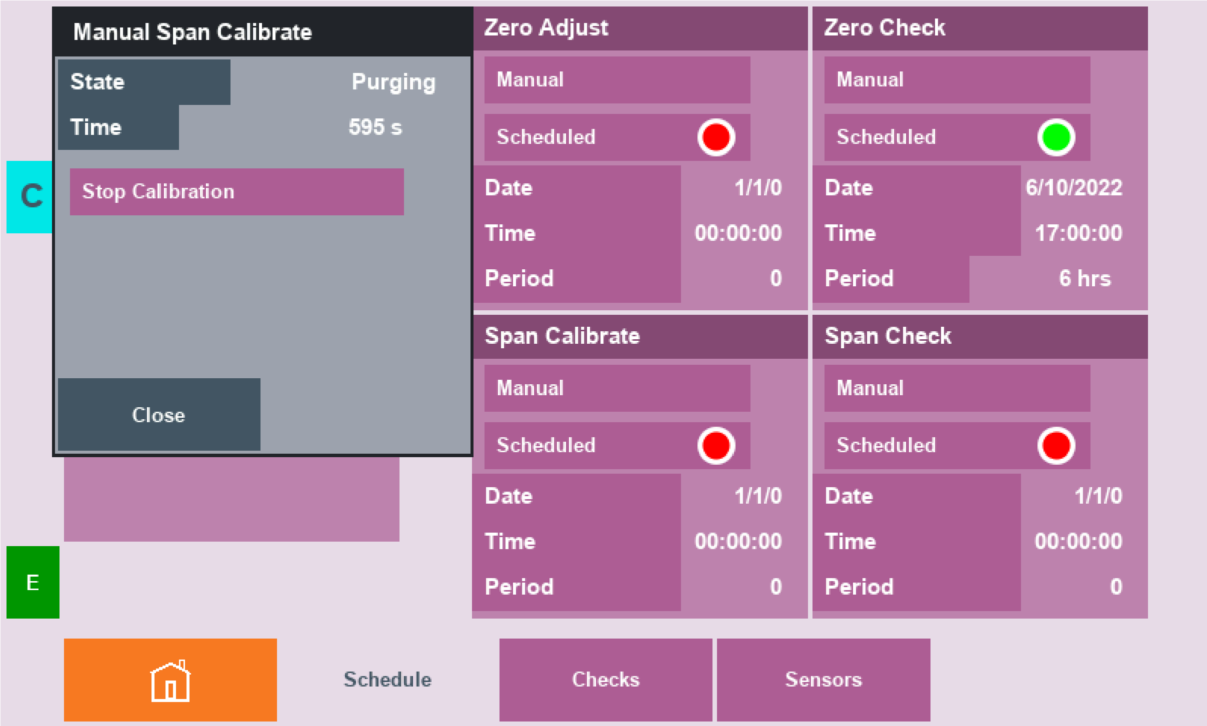


Figure 72 – Manual Span Calibrate Dialog Box

Pressing the stop calibration button will popup a confirmation dialog box, selecting cancel will close the dialog box and continue with the calibration, selecting accept will change source valves back to sample and change the state to complete and run a purge.

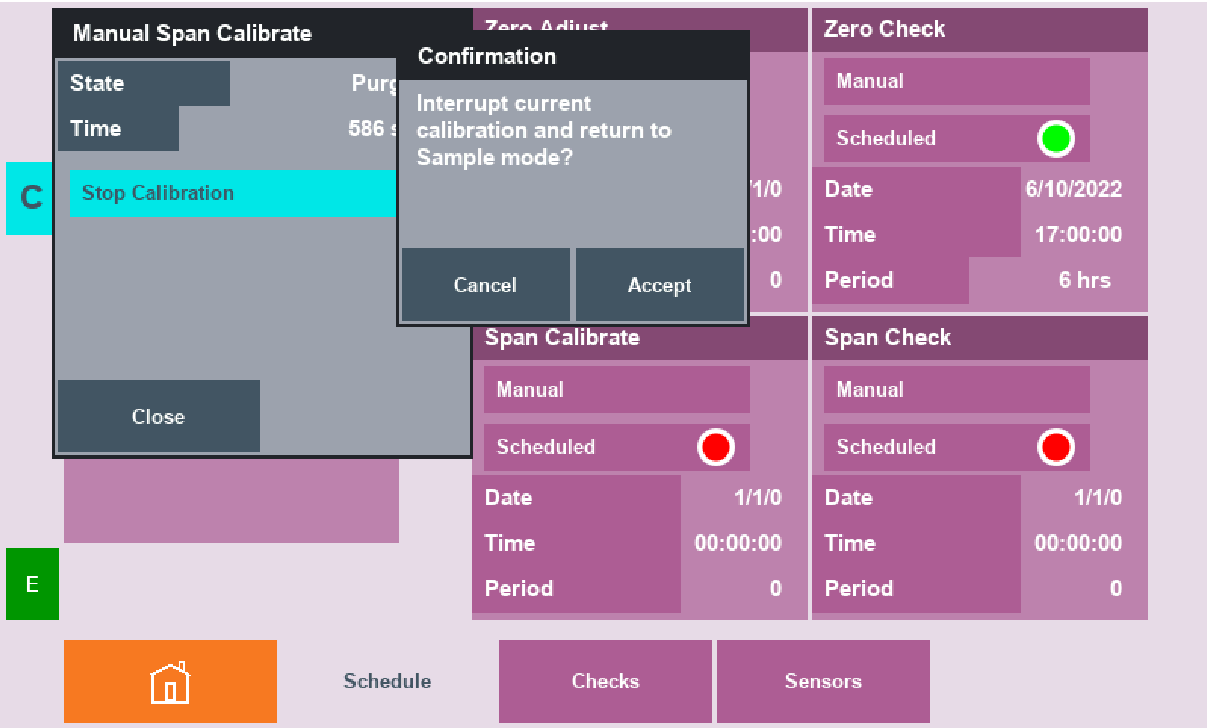


Figure 73 – Stop Calibration Confirmation Dialog Box

Note: Pressing stop calibration again will override the purge state and completely stop the calibration.

3.4.5.5 Span Check

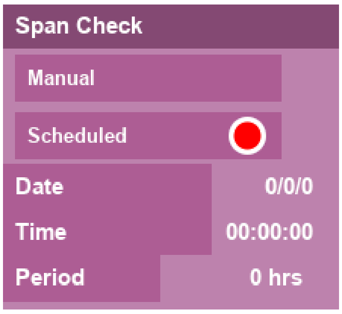


Figure 74 – Span Check Panel

This panel is used to schedule or perform a span check. A check switches to the span source and does a full measurement cycle, but does not change the calibration values.

Note: If a field with a radio button is red, it is disabled. If it is green, it is enabled. Touching the radio button will alternate its state.

Pressing the manual button will bring up a confirmation dialog box

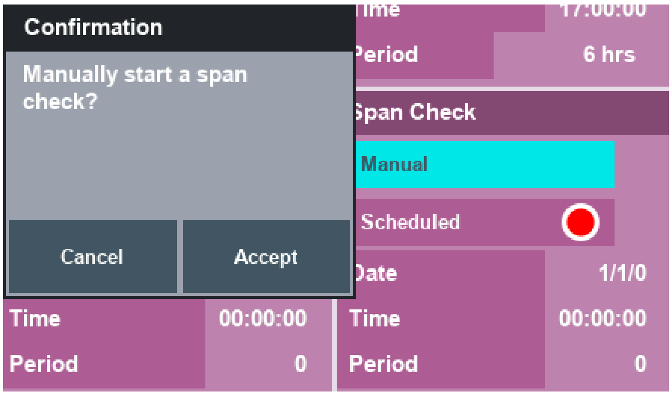


Figure 75 – Manual Span Check Confirmation Dialog Box

Selecting Cancel will revert the calibration without any effect; selecting Accept will proceed to start the calibration sequence. When the calibration sequence is started the calibration alert icon will appear on the left of the page.

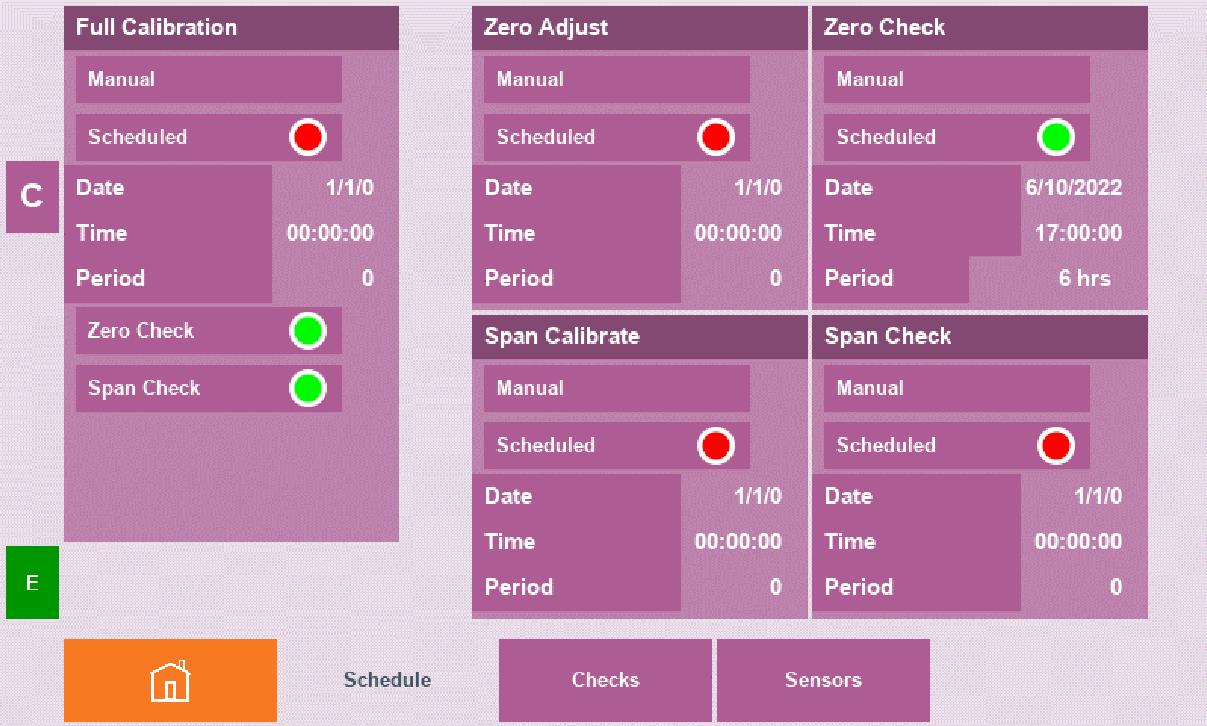


Figure 76 – Manually Started Span Check

Pressing the calibration alert will popup a manual span check dialog box. The dialog box presents the current state and time remaining in seconds. It also has a stop calibration button.

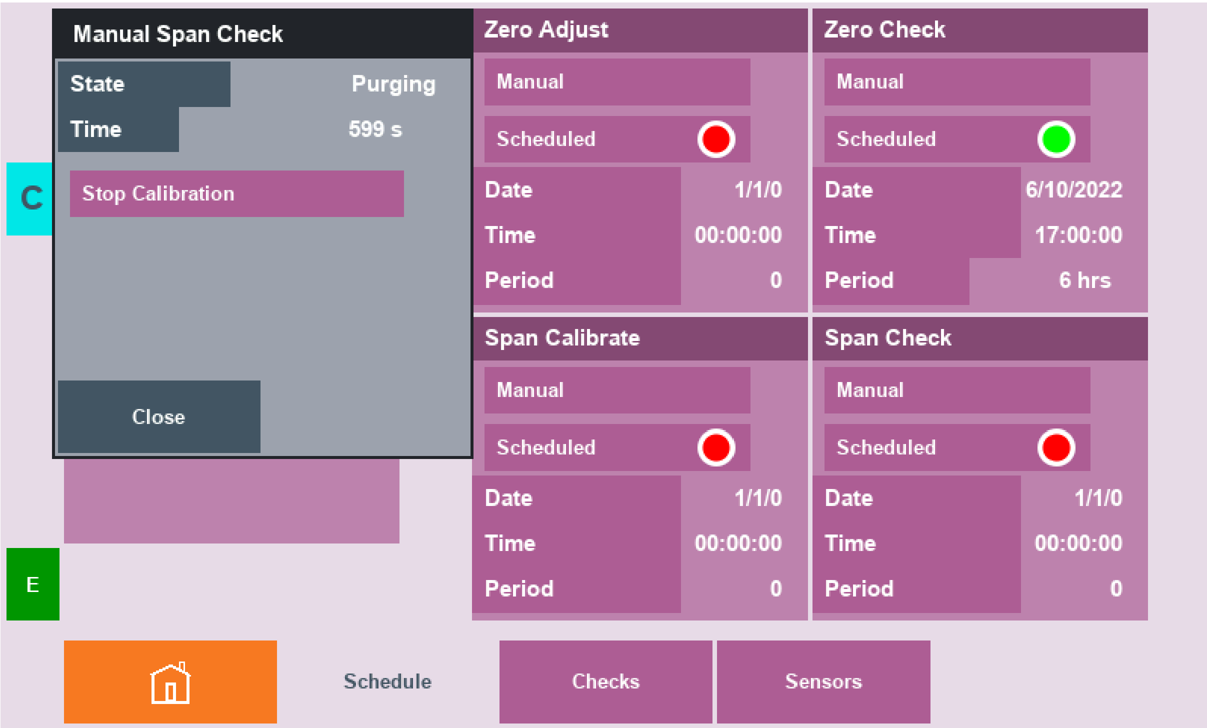


Figure 77 – Manual Span Check Dialog Box

Pressing the stop calibration button will popup a confirmation dialog box, selecting cancel will close the dialog box and continue with the calibration, selecting accept will change source valves back to sample and change the state to complete and run a purge.

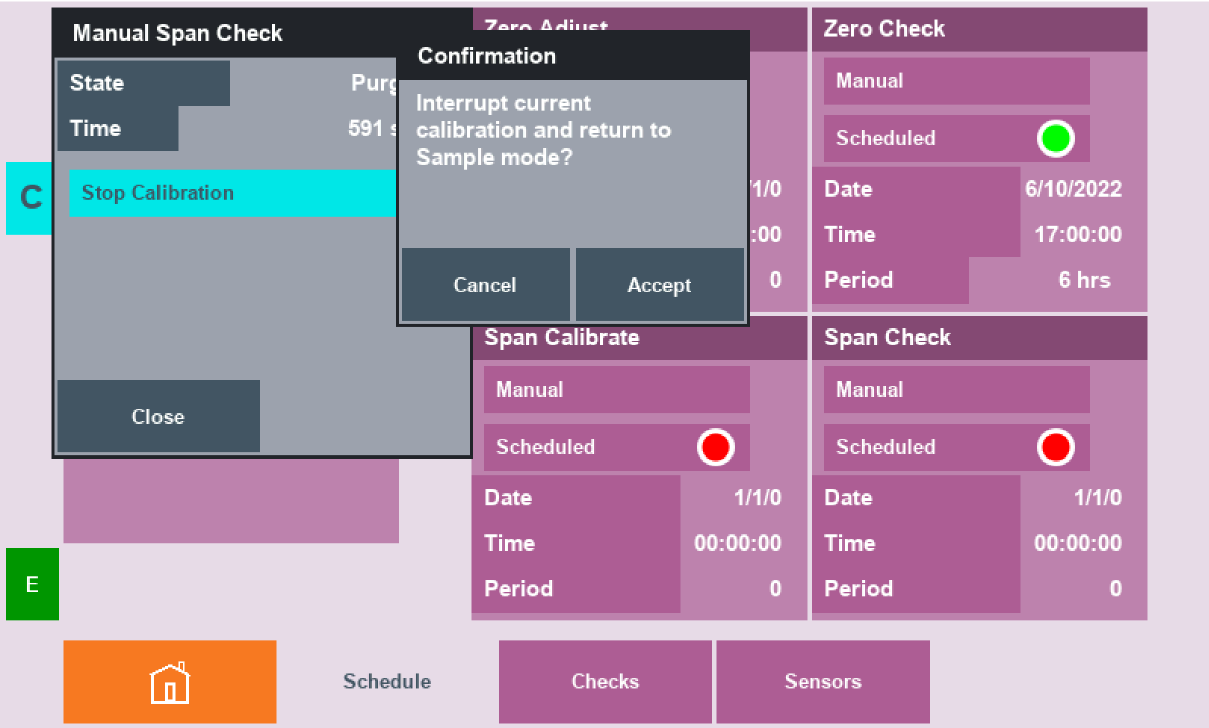
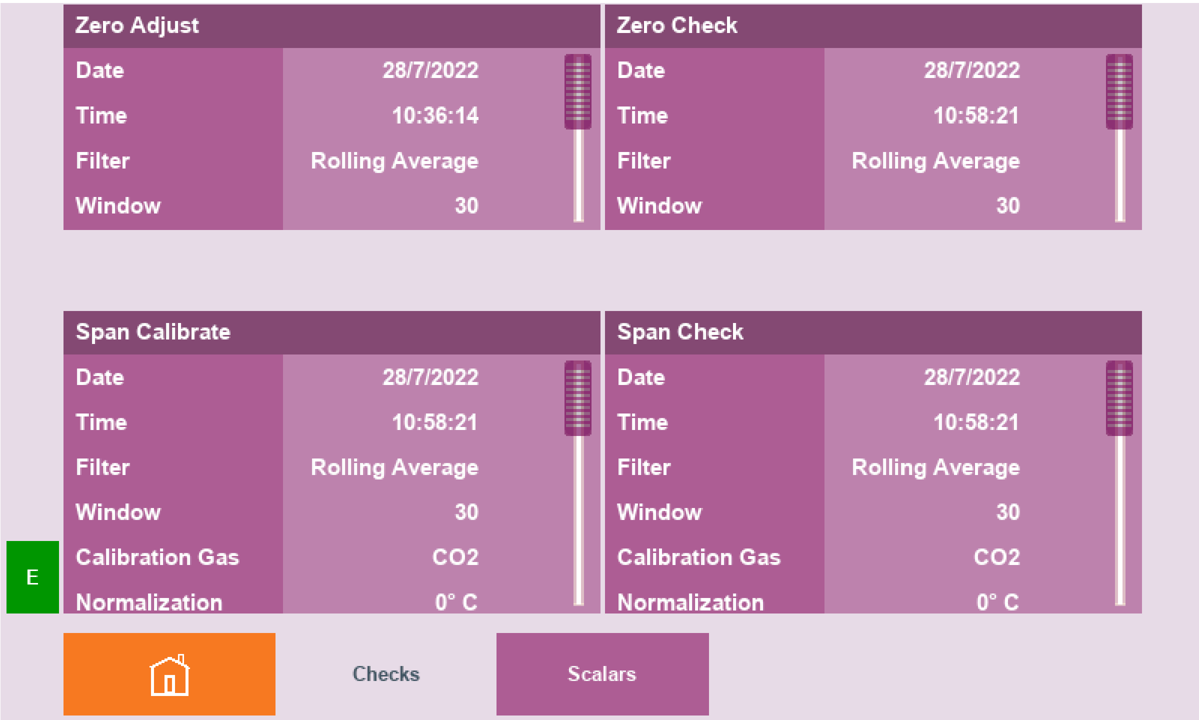


Figure 78 – Stop Calibration Confirmation Dialog Box

Note: Pressing stop calibration again will override the purge state and completely stop the calibration.

3.4.6 Checks



The checks child page displays the status of the most recent calibrations and precision checks. It is made up of four panels; zero adjust, zero check, span calibrate and span check. On each panel in addition to the settings at the time of the calibration, it also shows the sigmas and measure ratios for each wavelength and angle. Use the angle field to change which angle is currently being displayed.

Figure 79 – Checks Child Page Showing 0°

Using the touch method on the angle field on any of the panels will create a popup menu with the angles to select from.

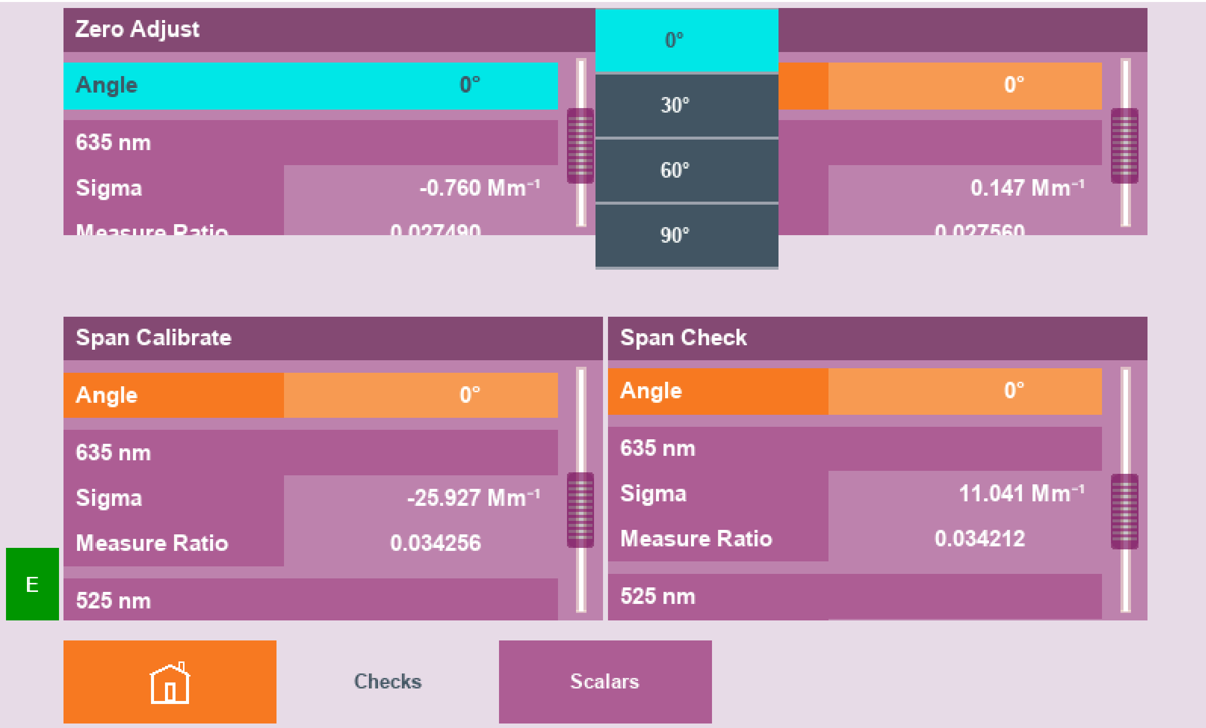


Figure 80 – Checks Child Page Angles Popup Menu

Selecting a new angle from the angle popup menu will now display that angles data for all panels.

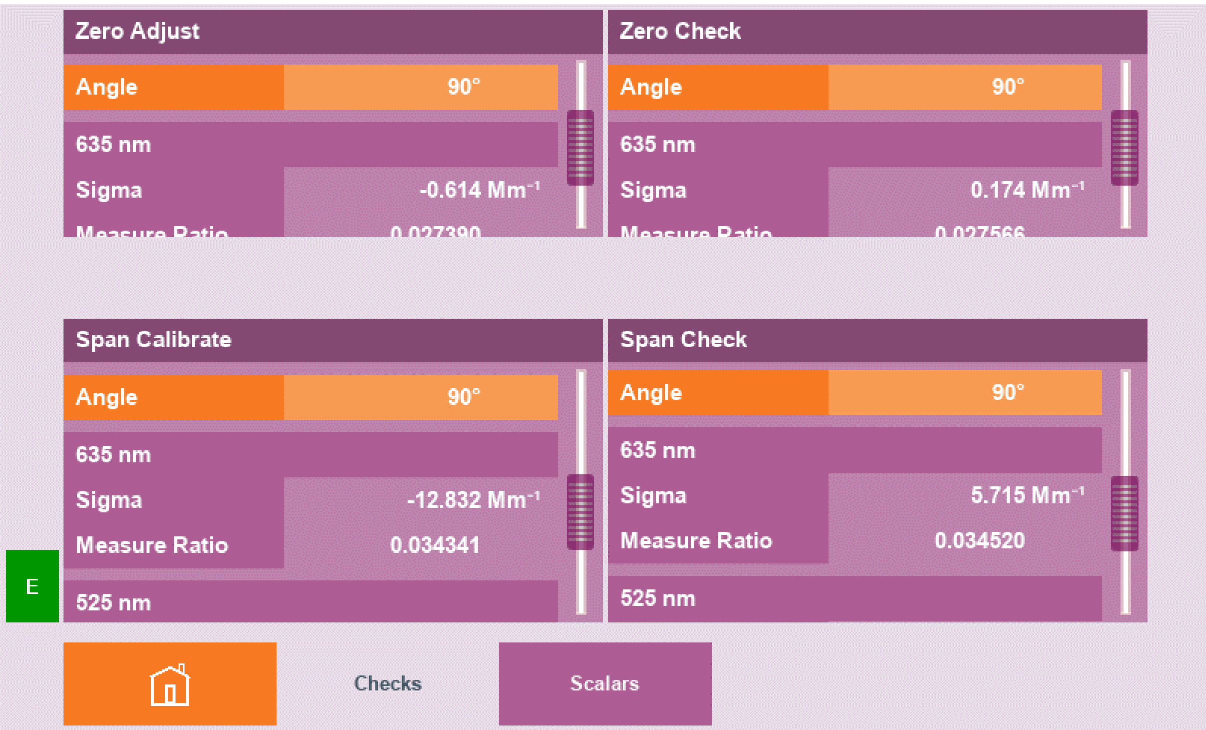


Figure 81 – Angle changed from 0° to 90°

3.4.6.1 Zero Adjust

The last zero adjustment results.

3.4.6.2 Zero Check

The last zero check results.

3.4.6.3 Span Calibrate

The last span calibration results.

3.4.6.4 Span Check

The last span check results.

3.4.7 Scalars

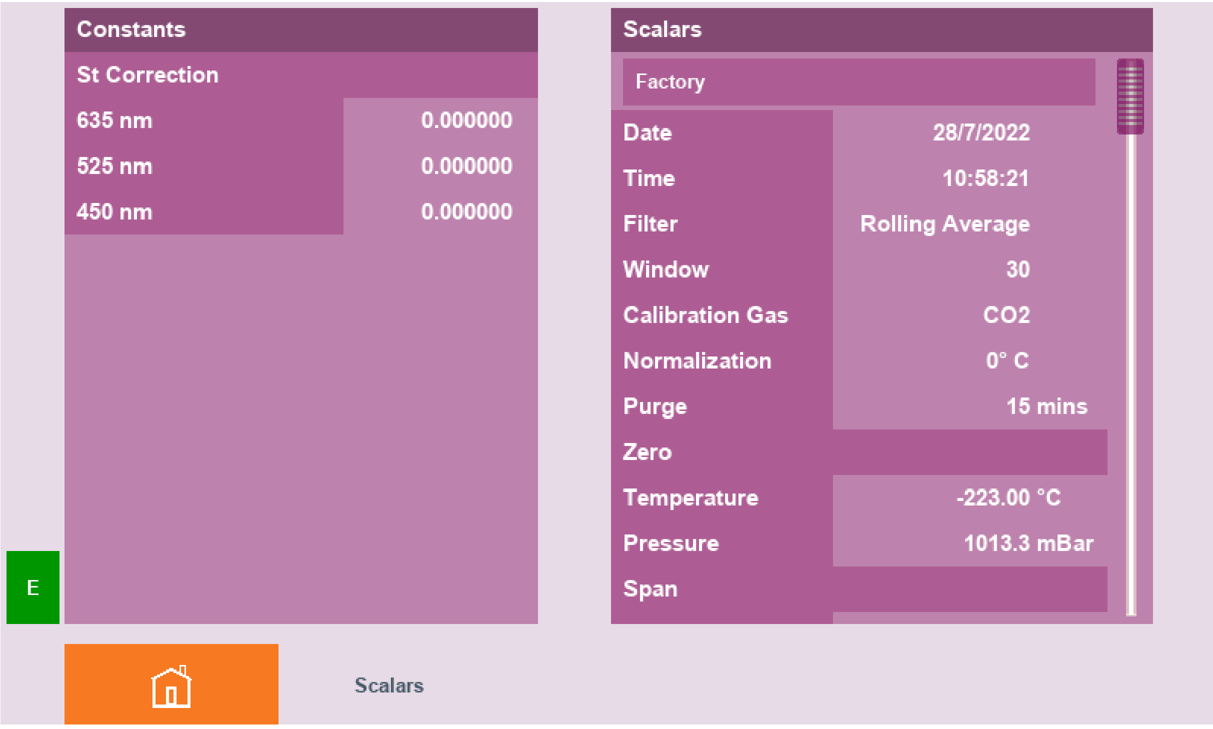


Figure 82 – Scalars Child Page

The scalars child page shows all of the numeric factors of the last actual calibration (whether it was a zero adjust or span calibration). This page is broken into two panels, the constants panel and scalars panel.

3.4.7.1 Constants

Figure 83 – Constants Panel

These are factory-specified correction values.

3.4.7.2 Scalars

Figure 84 – Scalars Panel

In addition to the calibration settings and environmental readings at the time of calibration, this panel shows the various calculated values for each wavelength and angle. This panel exists for trouble-shooting; you should not normally need to interact with it.

The factory button at the top of the panel will restore calibration values to the factory defaults, which will not be as accurate as performing a calibration.

3.4.8 Sensors

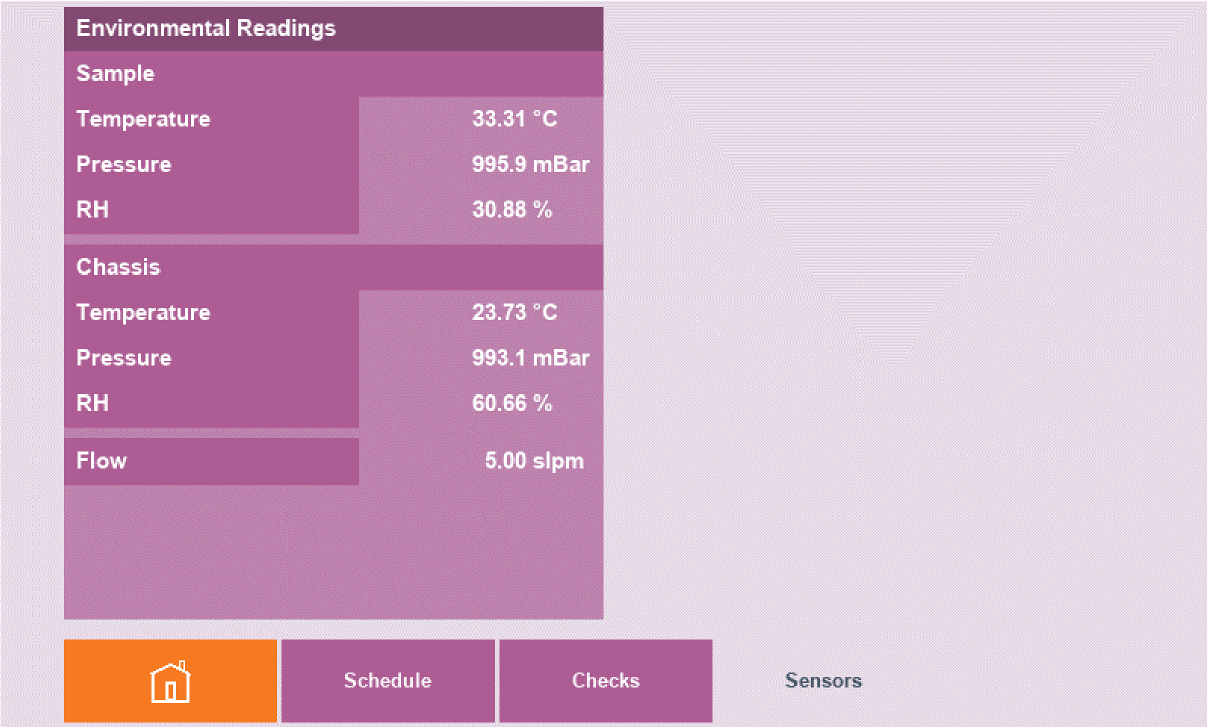


Figure 85 – Sensors Child Page

The sensors child page has one main panel, environmental readings. The environmental readings panel shows the current sensor reading updated every second. The user can use the touch and hold method on each field to change the definition of that field. This includes the fields units, decimal places and sensor calibration.

3.4.8.1 Environmental Readings

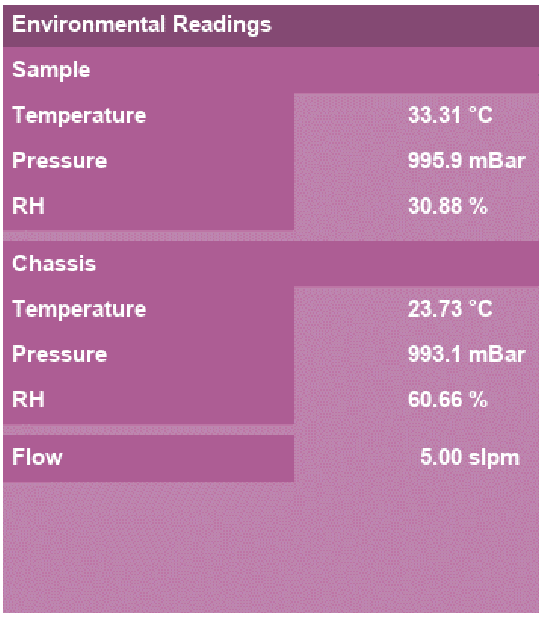


Figure 86 – Environmental readings Panel

The environmental sensor information is presented in this panel. The information is grouped by headings and represented by the following fields:

Sample

- The current sample temperature, pressure, RH

Chassis

- The current chassis temperature, pressure, RH

- The current sample flow

Form this panel the user can change the definition of each field using the touch and hold method to activate the popup menu. This includes the fields units, decimal places and sensor calibration.

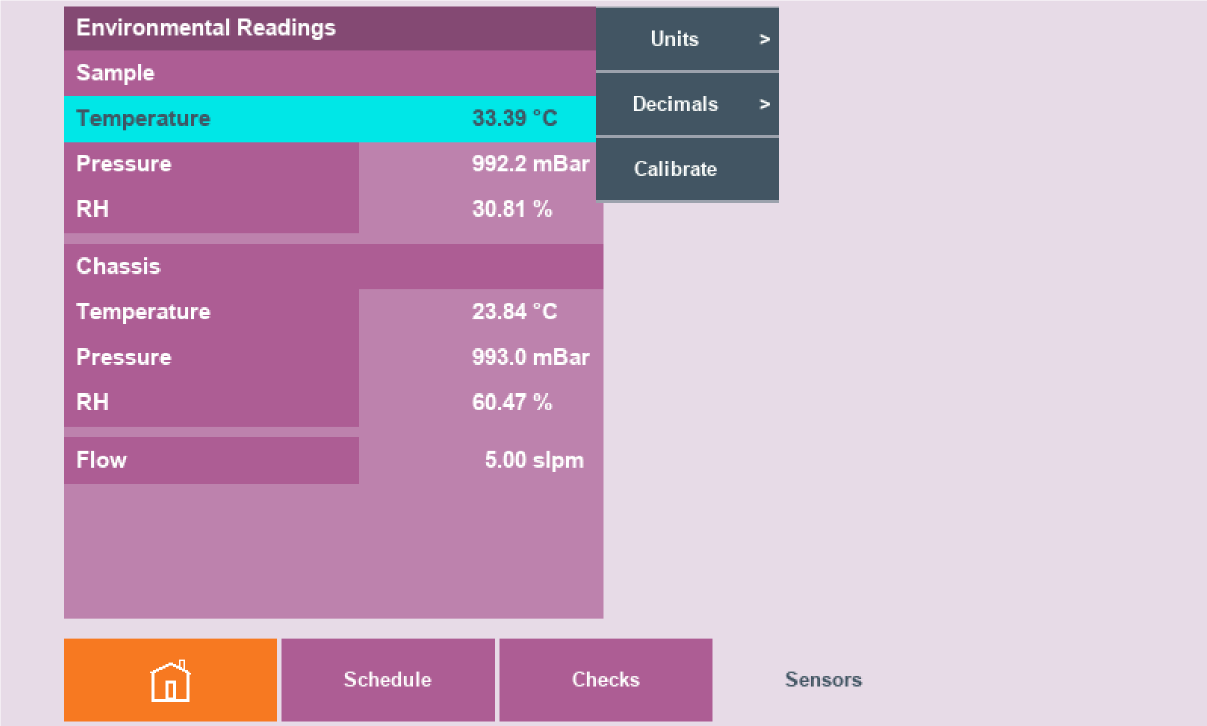


Figure 87 – Sample Temperature Popup Menu

Touching the units menu item expands the available options.

Figure 88 – Sample Temperature Popup Menu Units Expanded

Touching the decimals menu item expands the available options.

Figure 89 – Sample Temperature Popup Menu Decimals Expanded

Note: There are a number of options to select from for the decimal places menu, use the touch and hold method followed by a drag up or down to view the full menu.

Touching the calibrate menu item will popup a calibration dialog box allowing the user to calibrate the sensor. This will be covered in more detail in the calibration section (refer to Section 5).

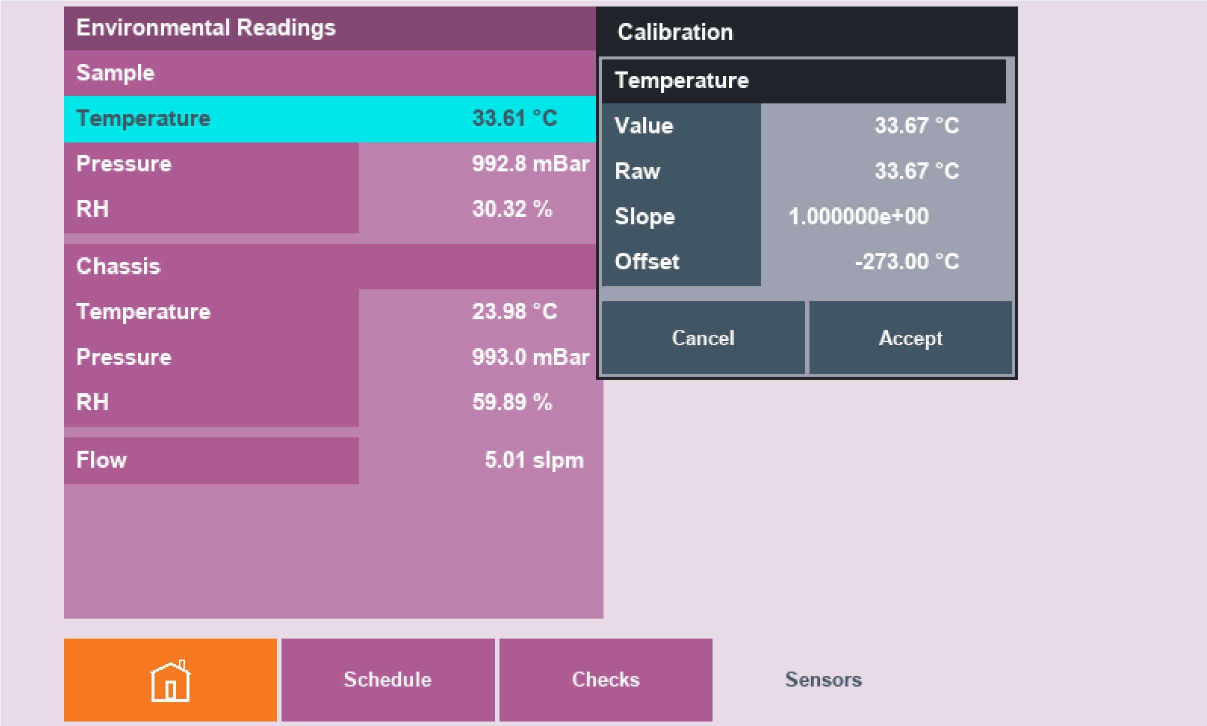


Figure 90 – Sample Temperature Calibration Dialog Box

Selecting cancel will close the dialog box and revert any changes, selecting accept will apply the changes to the sensor.

3.4.9 Comms

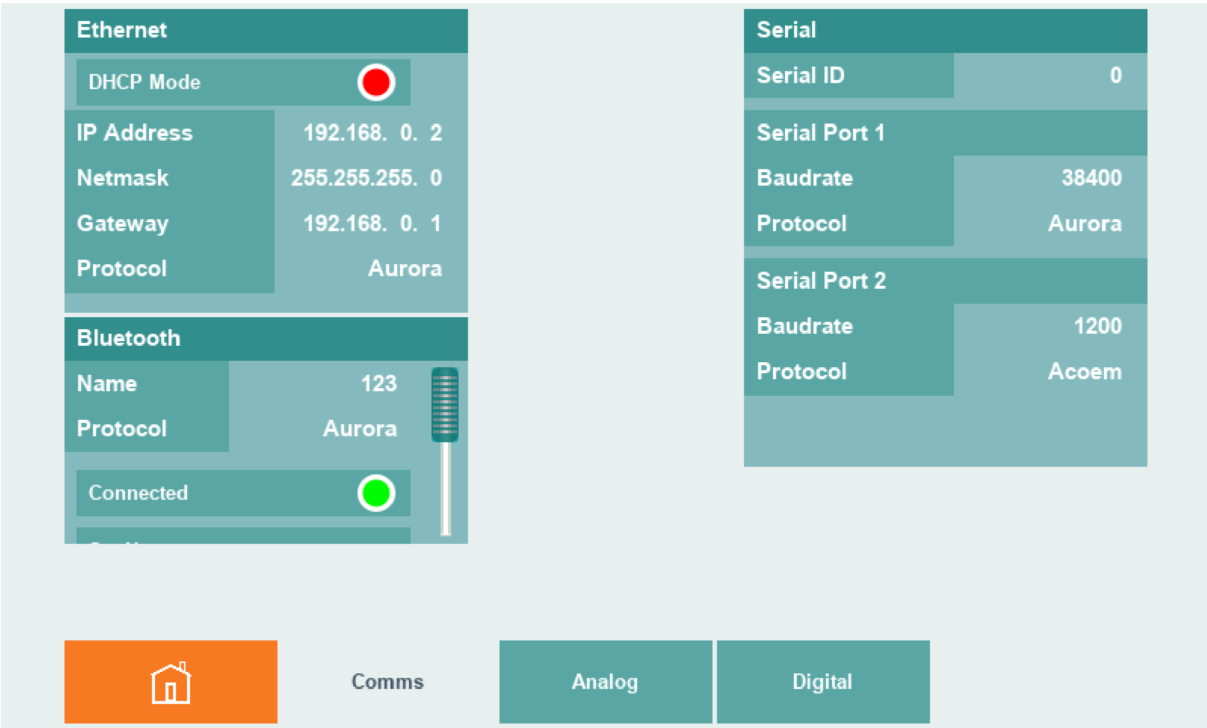


Figure 91 – Comms Page

The communications page and child pages control the settings for various interfaces. The comms page is made up of three panels; ethernet, serial and Bluetooth.

3.4.9.1 Ethernet

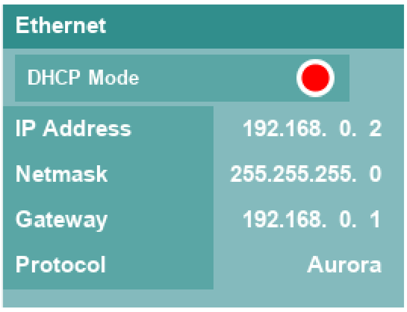


Figure 92 – Ethernet Panel

The ethernet panel has all the information relating to the specific settings of the ethernet port. These fields can be altered to suit the users network configuration.

DHCP mode means the instrument requests an IP address from its gateway.

Protocol selects how the instrument communicates: either the Aurora legacy protocol (not recommended) or the Acoem protocol.

This is described in more detail in the Communication Section (refer to Section 4).

3.4.9.2 Bluetooth

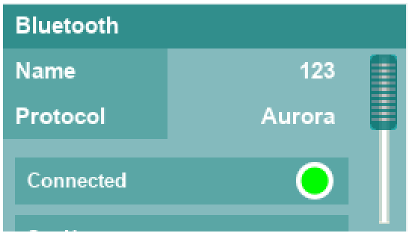


Figure 93 – Bluetooth Panel

The Bluetooth panel has two fields one radio button and two buttons.

The name field is an identifying name for the instrument; this number will be proceeded with “AuroraNE-400_.”

The protocol field selects how the instrument communicates: either the Aurora legacy protocol (not recommended) or the Acoem protocol.

The connected radio button indicates that the instrument is paired with another device; to break the pairing press this button.

The set name button TBA.

The reset button TBA.

3.4.9.3 Serial

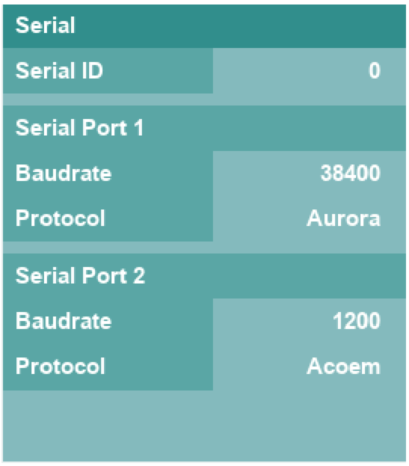


Figure 94 – Serial Panel

The serial ID is used in multi-drop configurations. If not using a multi-drop cable it is recommended to leave this value at 0.

The baudrate and protocol fields can be specified for each of the serial ports independently.

The protocol field selects how the instrument communicates: either the Aurora legacy protocol (not recommended) or the Acoem protocol.

3.4.10 Analog

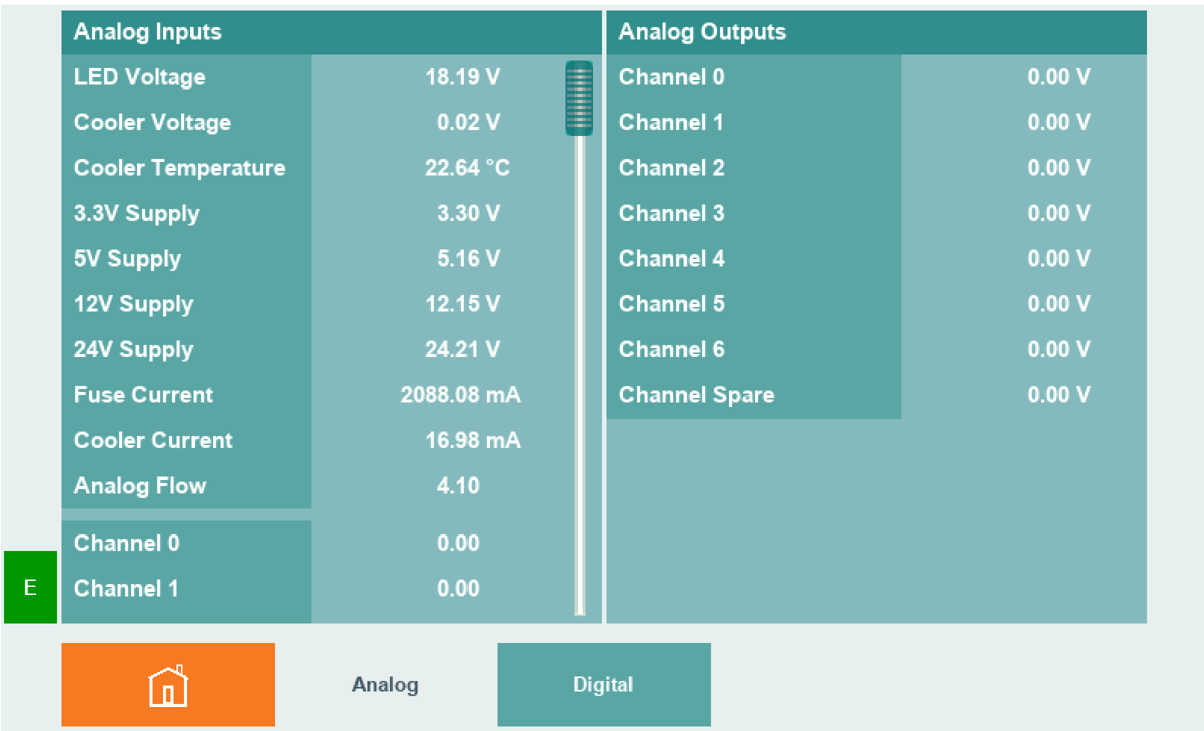


Figure 95 – Analog Child Page

Analog communications are configured here.

3.4.10.1 Analog Inputs

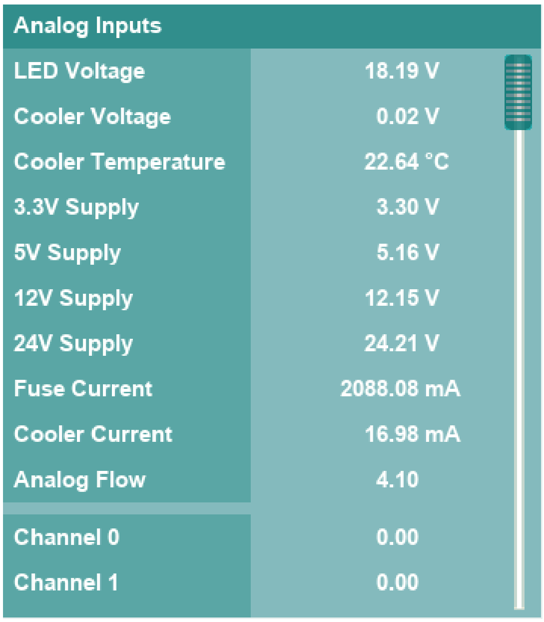


Figure 96 – Analog Inputs Panel

Each of the analog inputs in the system are displayed as fields on this panel. Scroll down to see the readings from the external analog inputs. If you enable service menus (refer to Section 3.4.12), extra information is available to enable you to edit the slope and offset and reference voltage for external analog inputs.

3.4.10.2 Analog outputs

Figure 97 – Analog Outputs Panel

Each of the analog outputs in the system are displayed as fields on this panel. Each field has a heading that can be selected using the touch method. Doing so will popup a datalog parameter menu where the parameter, max, min and offset can be configured.

Currently there is no method for calibrating any of the analog outputs.

Using the touch method on the channel field will bring up the num pad, a value can be entered between 0-5 to simulate the analog output value.

3.4.11 Digital

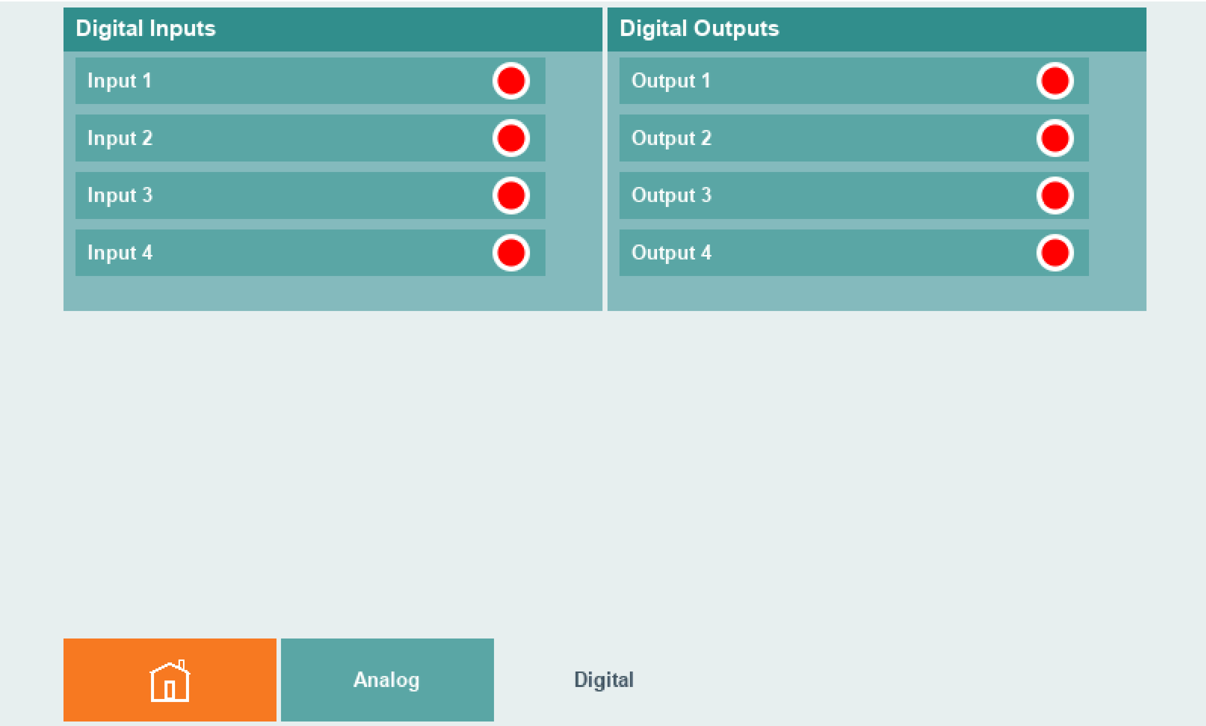


Figure 98 – Digital Child Page

Digital IO for the instrument.

3.4.11.1 Digital Inputs

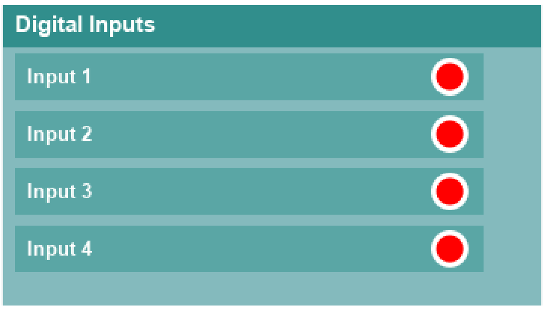


Figure 99 – Digital Inputs Panel

Not yet supported.

3.4.11.2 Digital Outputs

Not yet supported.

3.4.12 Config

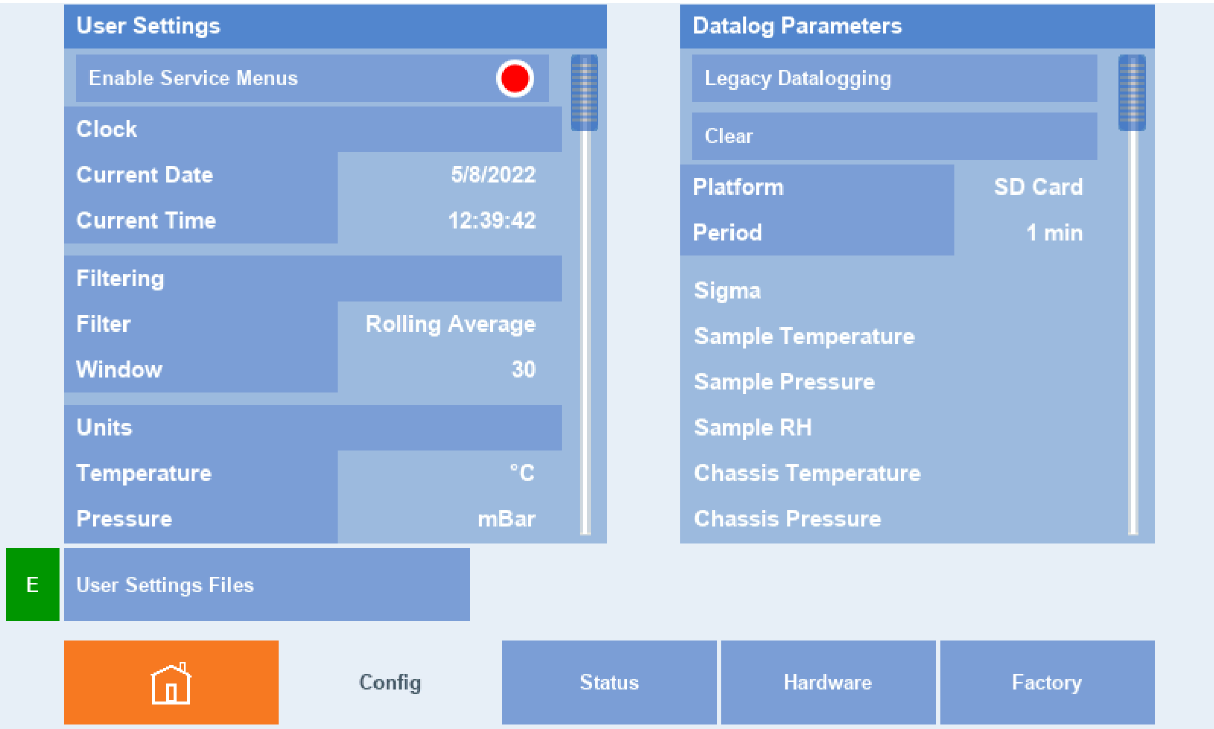


Figure 100 – Config Page

This page manages the user settings and data logging. It has two panels and a button; the user setting panel, datalog parameters panel and the user settings files button.

The configs child pages, status, hardware and factory are intended only for technician use.

3.4.12.1 User Settings

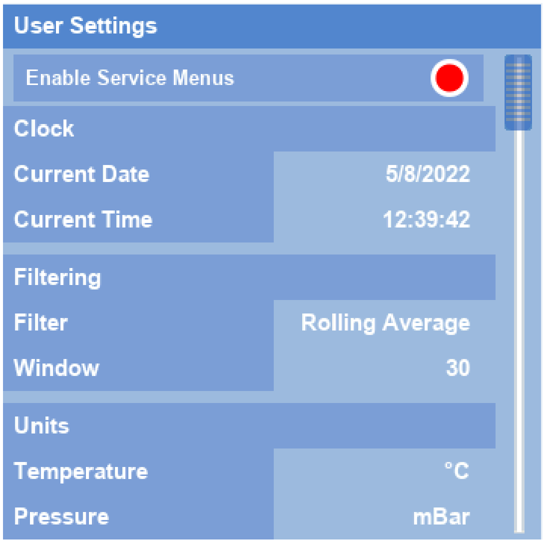


Figure 101 – User Settings Panel

The user settings information is presented in this panel. The information is grouped by headings and represented by the following fields and buttons:

At the top of the user settings panel there is a radio button to enable service menus. Touching this button will toggle the radio button and activate or deactivate service menus.

Clock

- The Clock section allows setting the current time and date.

Filtering

- The Filter field is the same as the field on the home page – it changes what data is displayed.

Units

- Units and Decimals allow specifying the unit system and number of decimal places various parameters will be displayed in.

3.4.12.2 Datalog Parameters

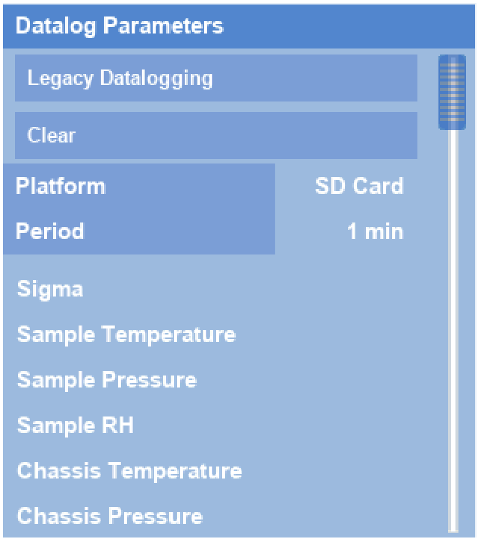


Figure 102 – Datalog Parameters Panel

The datalog parameters information is presented in this panel. The information is represented by the following fields, parameter list and buttons:

At the top of the datalog parameters panel we have the legacy button. This button sets the Aurora NE Series to emulate an Aurora 4000 as closely as possible. This may be useful for legacy installations but it does not take full advantage of the power of the Aurora NE Series.

The clear button will erase all parameters.

Platform determines where the data log files are stored; the SD Card is recommended as it is faster and much larger.

Period determines how often data is logged. A time interval can be specified, or you can choose “All” which means that data will be logged after every measurement cycle (all wavelengths and angles) has been completed.

To change what is logged simply touch one of the existing parameters or the None at the end. A dialog box appears allowing you to specify the parameter.

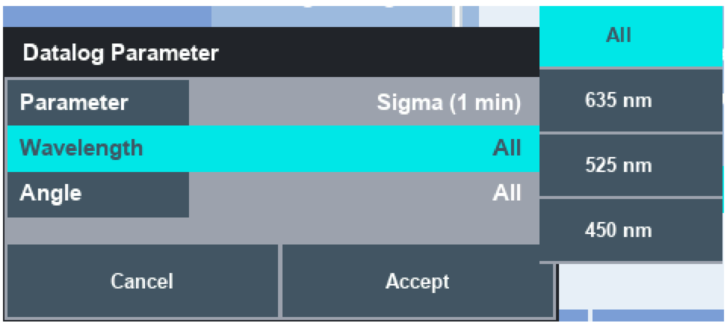


Figure 103 – Datalog Parameter Dialog Box

Be aware that simply asking for some parameters (such as Sigma) means logging up to sixty parameters; a sigma for every measured wavelength and angle. You can specify a smaller subset by selecting just one wavelength and/or one angle to be logged.

Note: The system can log any combination of filtered values, regardless of what is being displayed on the main menu (since all filtered values are maintained throughout the measurement cycle).

3.4.12.3 User Setting Files

Figure 104 – User Settings Files Button

Using the touch method press the user setting files button. This will popup a user settings dialog box.

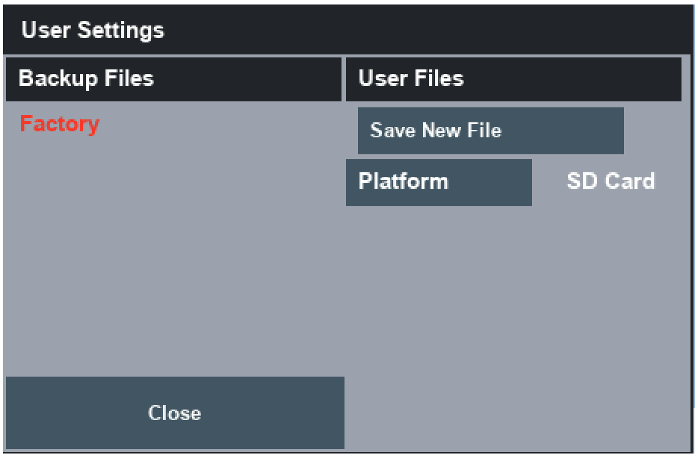


Figure 105 – User Settings Dialog Box

User setting configurations can be saved, loaded, copied to USB or deleted using this dialog box.

The factory file restores the user settings to the way it was when it left the factory.

3.4.12.3.1 Backup Files

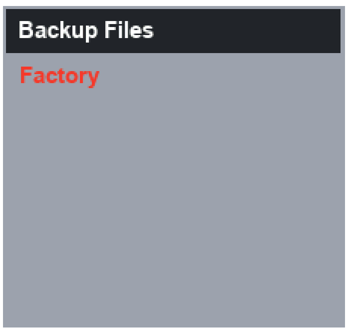


Figure 106 – Backup Files

The backup files section of the user settings dialog box allows the user to restores the user settings back to the way they were when the Aurora NE Series left the factory.

When you use the press and hold method on the factory field it will change to a light blue background and you get an additional popup menu with the option to load or copy the file.

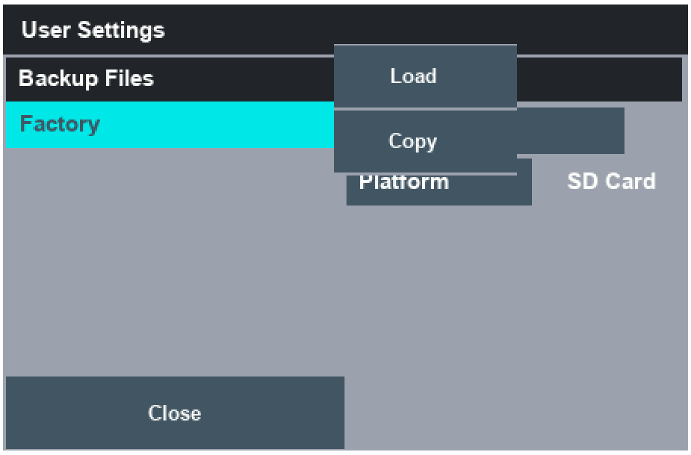


Figure 107 – Factory Backup File Load/Copy Popup Menu

Selecting load will popup a confirmation dialog box with information about the user setting configuration. Selecting Accept on the confirmation dialog box will proceed to load the factory user settings.

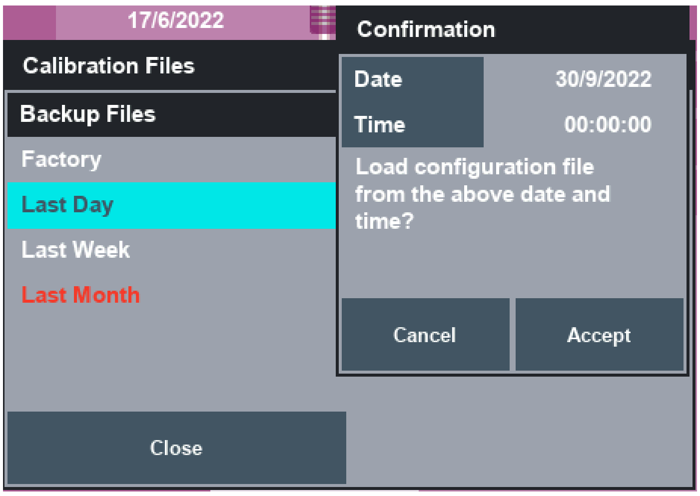


Figure 108 – Factory Backup File Load Confirmation Dialog Box

Selecting copy will copy the file to the USB.

3.4.12.3.2 User Files

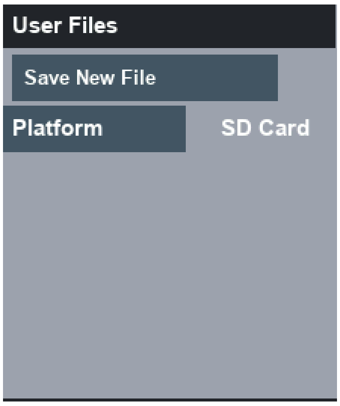


Figure 109 – User Files

In the user files section of the user settings dialog box we have a button to save a new user setting configuration, we have a field labelled platform that allows the user to select where the files are stored and under that we have a running list of user setting configuration saves the user has manually made using the save new file button.

To save a new calibration configuration press the save new file button. This will popup a save dialog box.

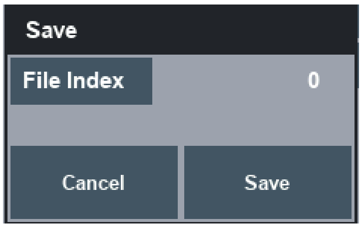


Figure 110 – Save Dialog Box

Using the touch method on the file index will bring up the keypad. Using the keypad type in the number for the user setting configuration save, form 0 - 99, then press the return key (refer to Section **Error! Reference source not found.** for keypad operation).

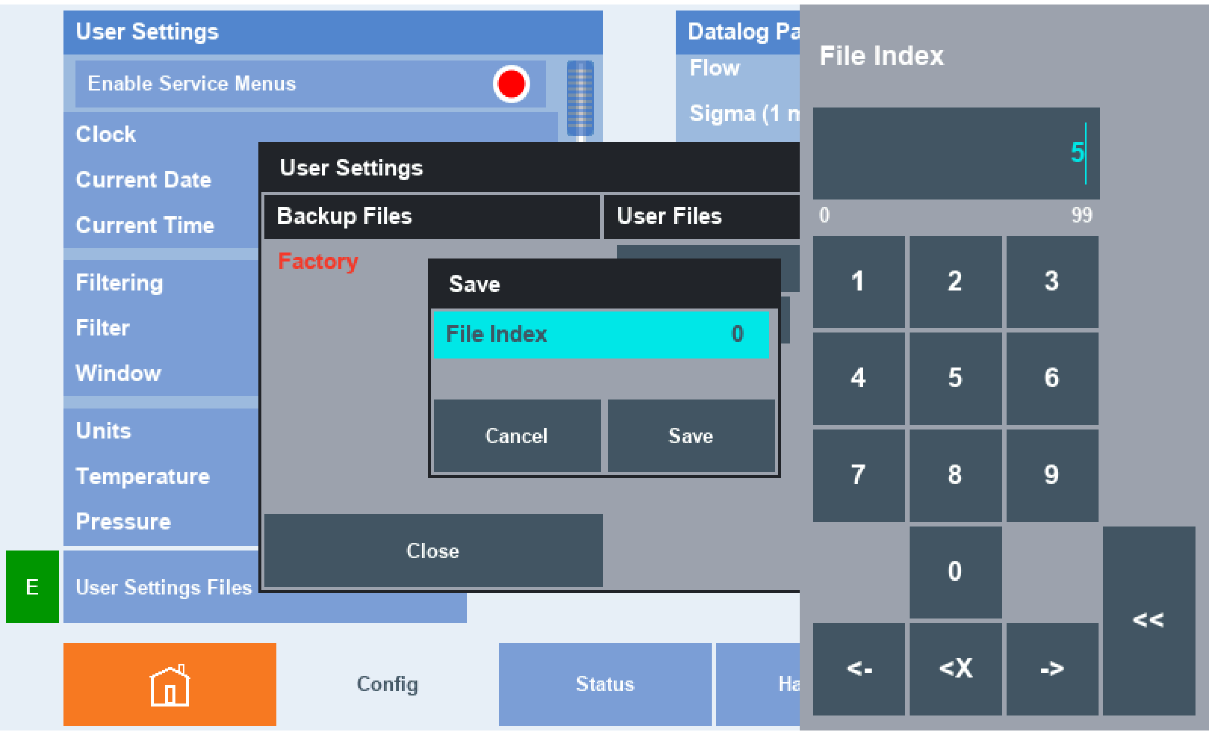


Figure 111 – Changing File Index From 0 to 5

After the save button is pressed a new user setting configuration save is created and added to the end of the list.

Note: New configuration saves are added to the end of the list and are displayed in the order they were saved, not in ascending or descending order.

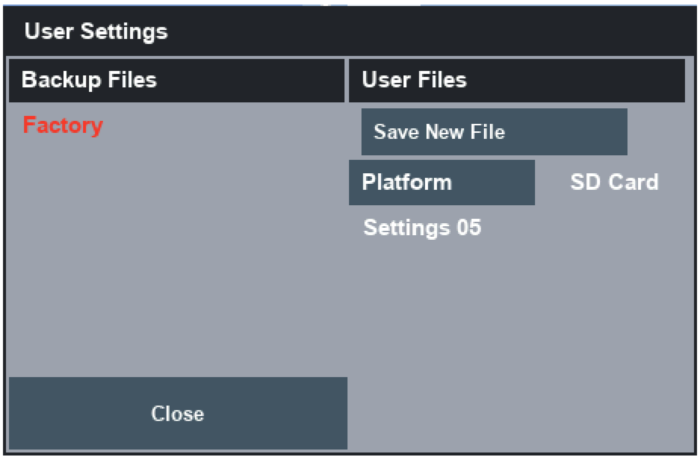


Figure 112 – New User Setting Configuration Save

Note: The user can have a total of 100 user setting configuration saves as the list increases the dialog box will be quite long. Use the scroll bar to move up and down the list.

Selecting any of the user setting configuration saves from the list with the touch and hold method will popup a menu with the following items, load, save delete and copy.

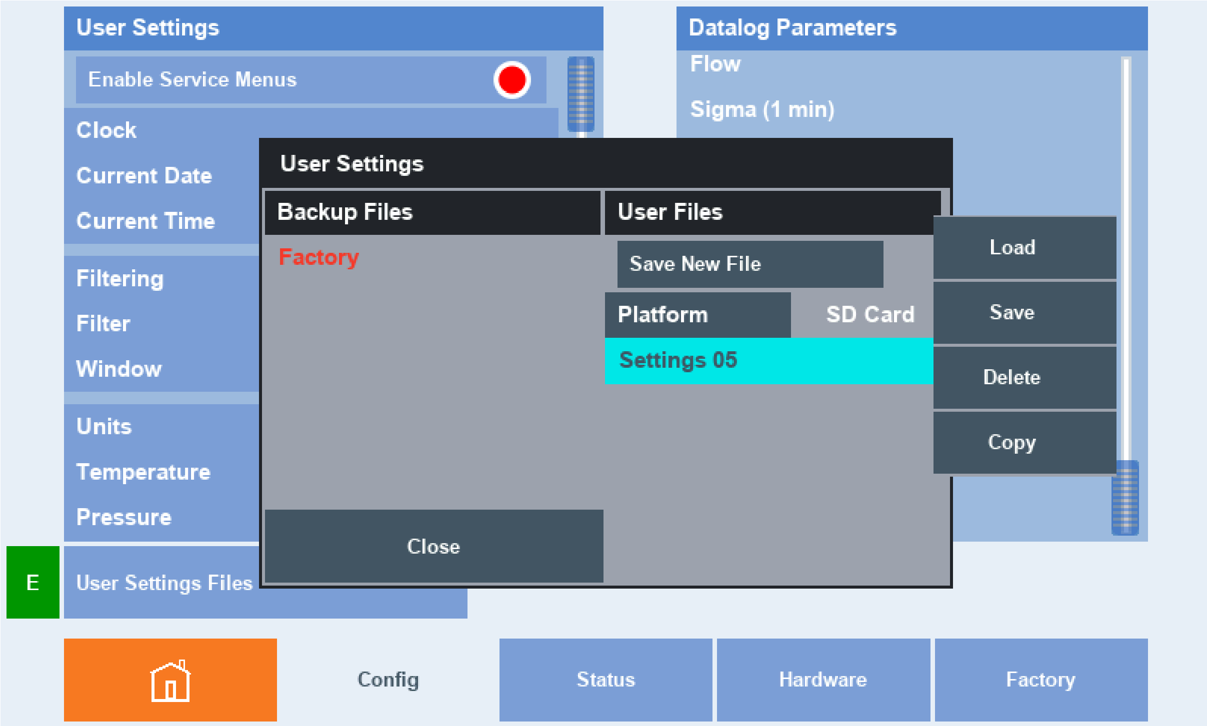


Figure 113 – User Settings Configuration Popup Menu

Selecting load will popup a confirmation dialog box information regarding the save. Selecting cancel will reject the action and selecting accept will load the user settings.

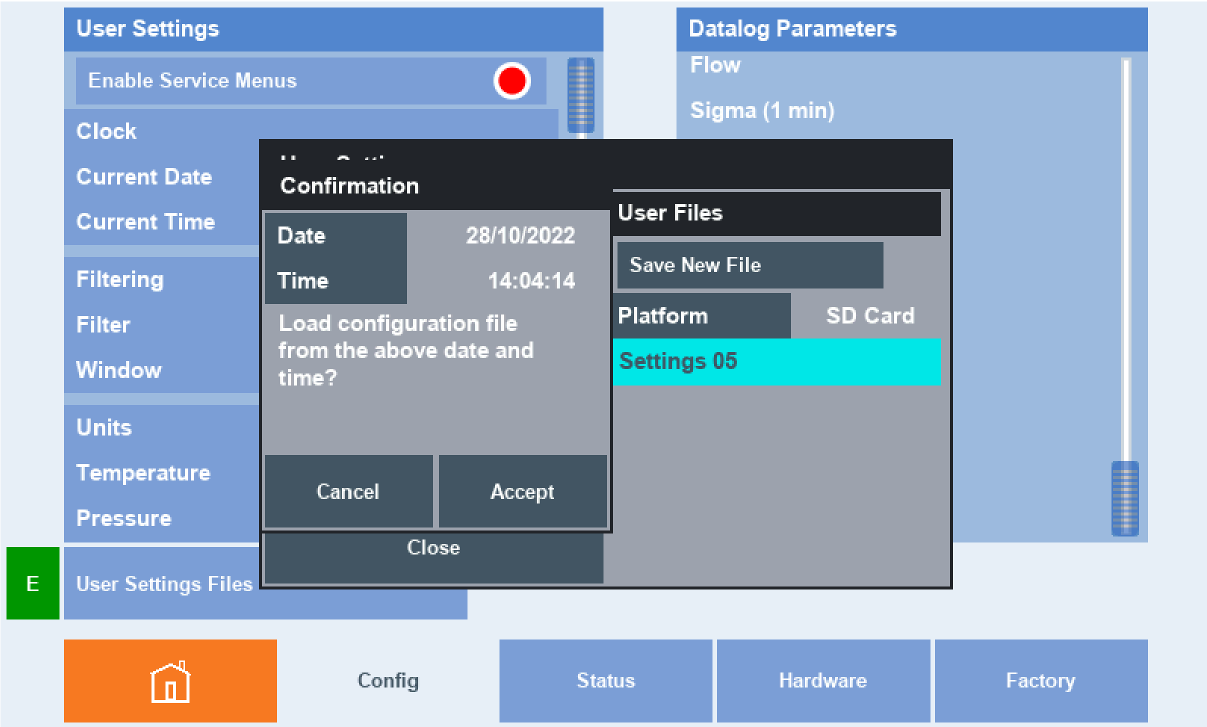


Figure 114 – User Settings Configuration Load Confirmation

Selecting save will popup a confirmation dialog box requesting to override the configuration with the current user settings. Selecting cancel will reject the action and selecting accept will override the saved user settings with the current user settings.

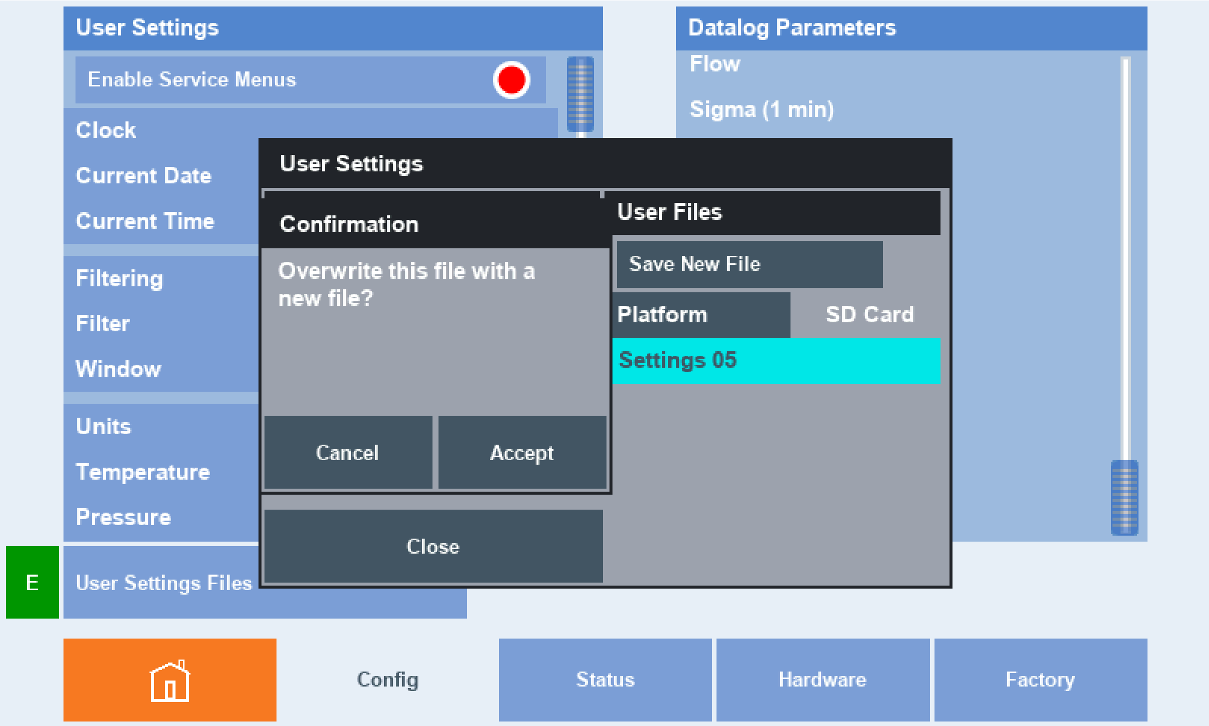


Figure 115 – User Setting Configuration Overwrite Confirmation Dialog Box

Selecting delete will popup a confirmation dialog box quiring the deletion of the user setting configuration. Selecting cancel will reject the action and selecting accept will delete the file removing it from the list.

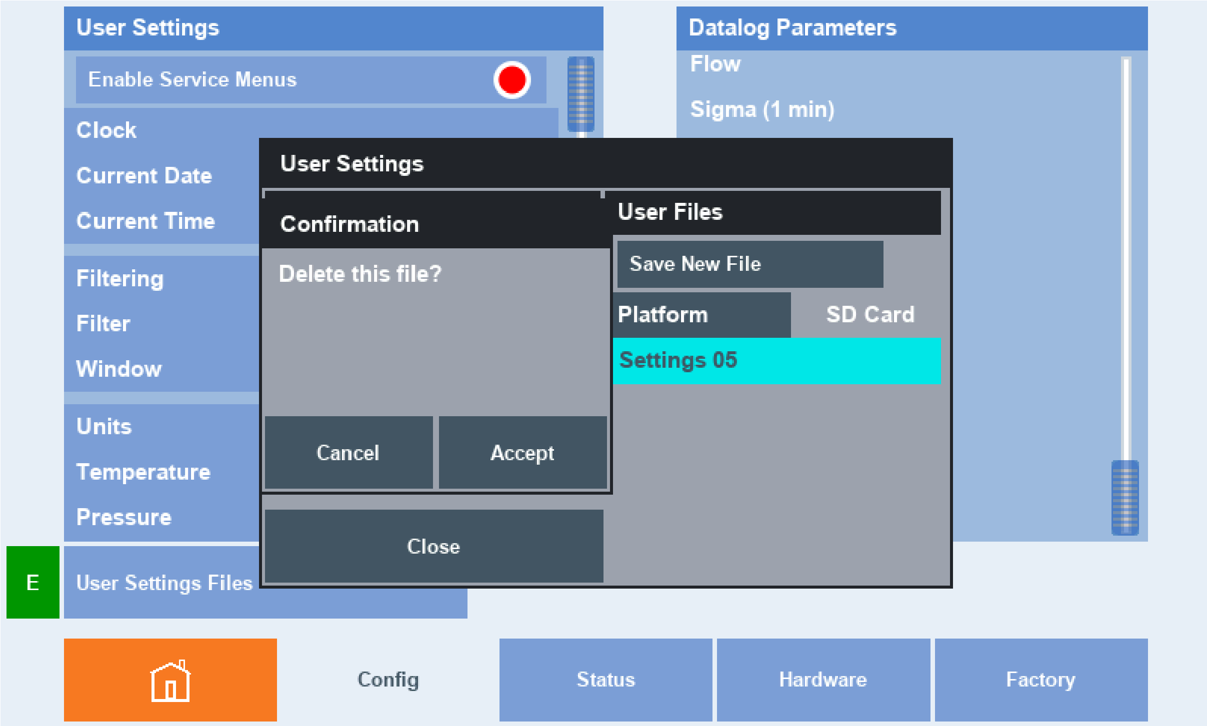


Figure 116 – Deleting Saved User Setting

Selecting copy will copy the file to the USB.

3.4.13 Config Status

Figure 117 – Status Child Page

This page reflects the status of the instrument as well as a history of previous events.

3.4.13.1 Instrument Status

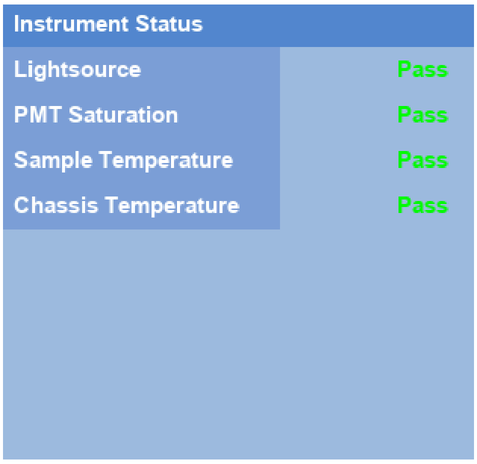


Figure 118 – Instrument Status Panel

A list of all possible error and warning states and their current value.

The buttons across the top allow sorting what statuses are displayed.

Figure 119 – Instrument Status Filter Radio Buttons

- G General
- W Warnings
- E Errors

3.4.13.2 Events

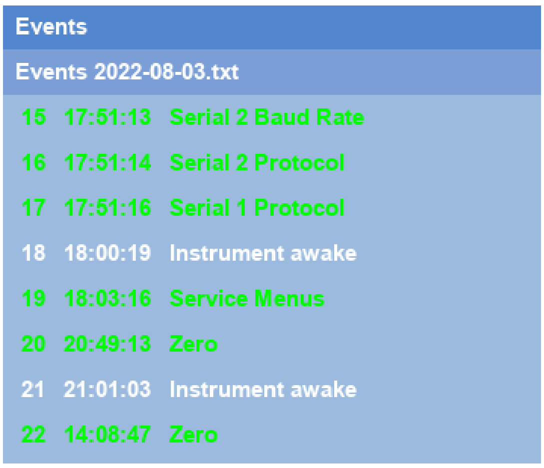


Figure 120 – Events Panel

This panel shows the event log for the instrument. By default, it points to the current date and time and updates as new events are added. You can use the buttons at the bottom to scroll up or down the list one line or one page at a time; holding down the page buttons will jump to the top or bottom of the list.

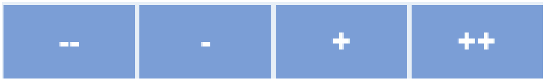


Figure 121 – Event Panel Navigation Buttons

The buttons at the top allow filtering of what events are displayed.

Figure 122 – Event Panel Filter Radio Buttons

- U User events
- I Instrument events
- W Warnings
- E Errors

3.4.14 Hardware

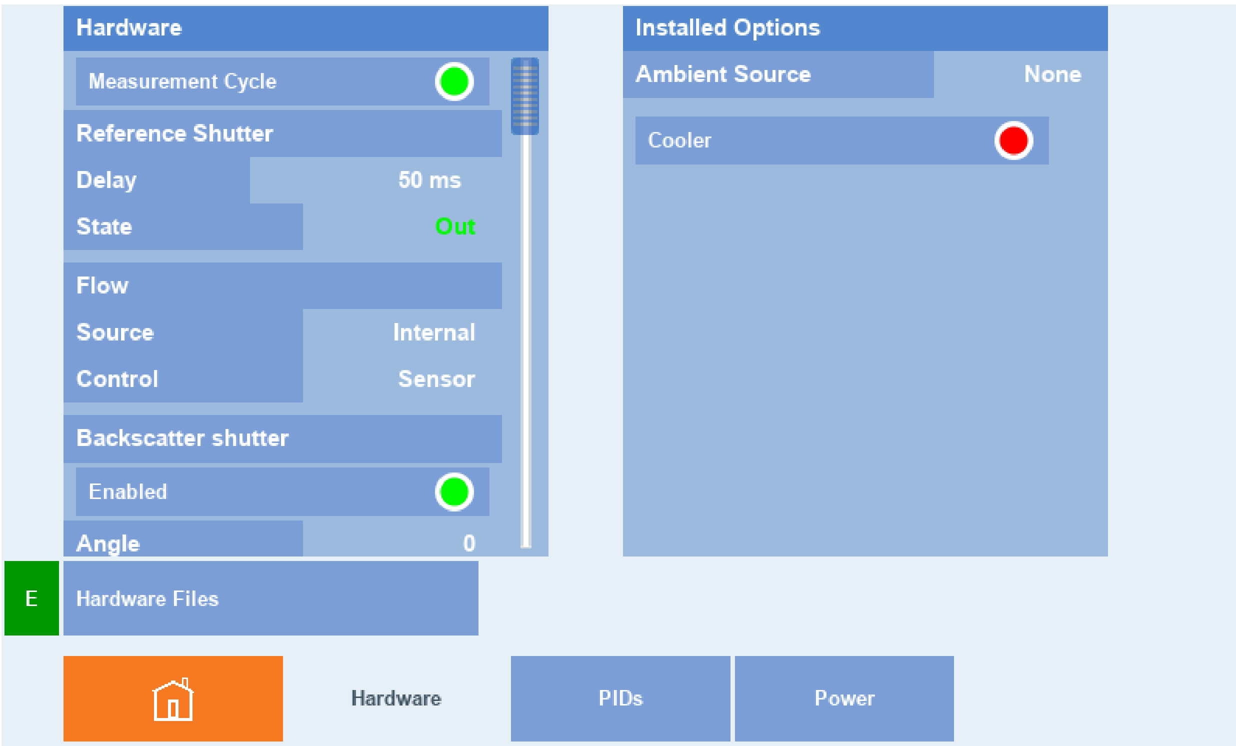


Figure 123 – Hardware Child Page

This child page manages specific user settings for the instrument's operation.

3.4.14.1 Hardware

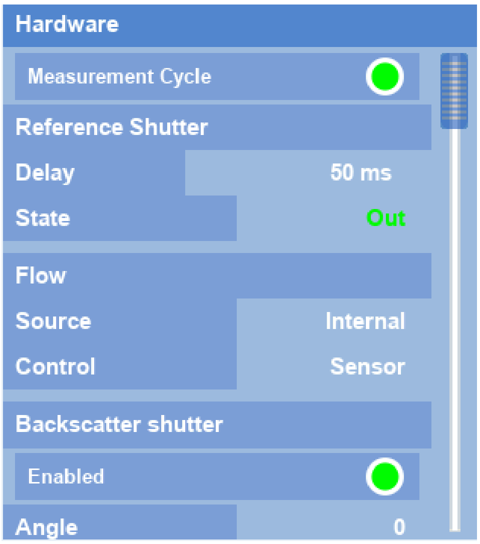


Figure 124 – Hardware Panel

Selection of the flow control type. Can be for internal flow sensor or MFC option with external pump.

3.4.14.2 Installed Options

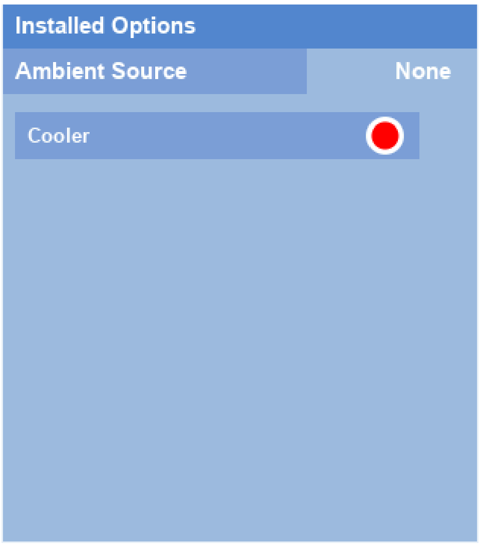


Figure 125 – Installed Options Panel

Ambient sensor selection if there is a requirement for external temperature and Pressure measurement. Enables the Internal PMT cooler if required.

3.4.15 PIDs

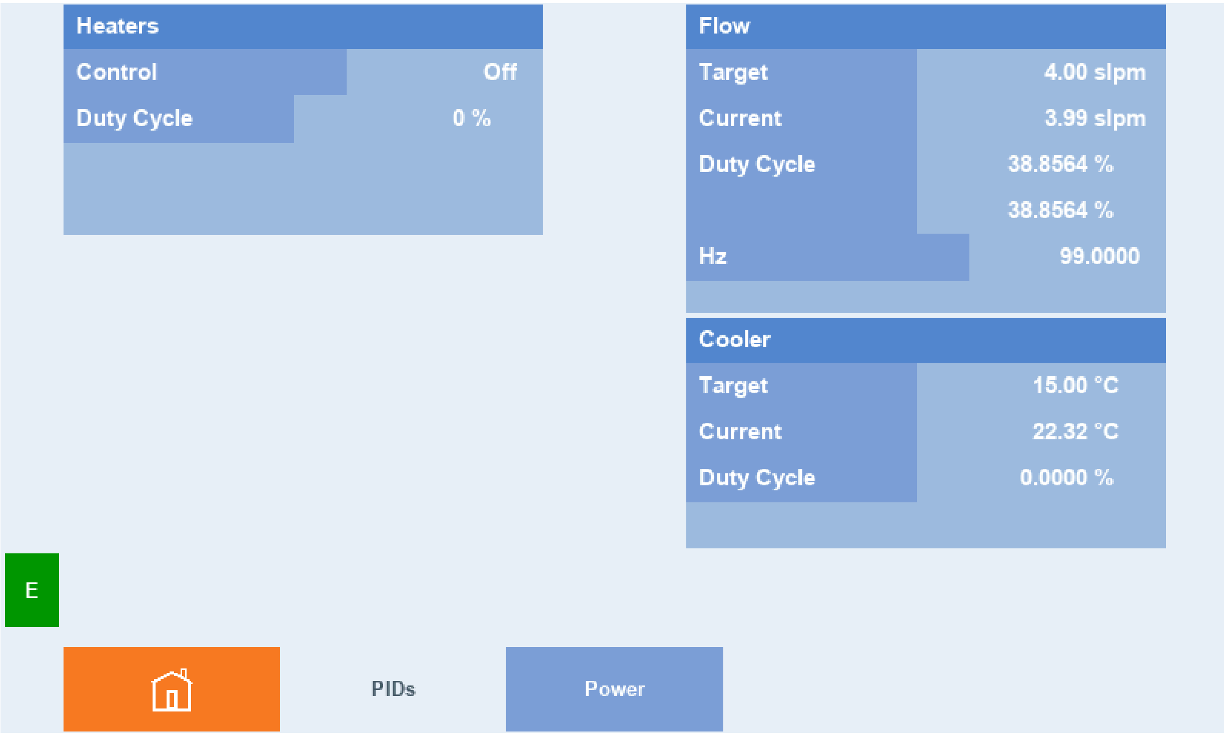


Figure 126 – PIDs Child Page

PID algorithms are used to control various parameters of the instrument.

3.4.15.1 Heaters

Sets the control of the sample inlet heater. It can be set to RH or temperature setpoint. Can set the setpoint and display the current reading and duty cycle.

3.4.15.2 Flow

Sets the control of the sample Flow. It can be set from 0 to 10 lpm. This can also be set in the Calibration menu. Can set the setpoint and display the current reading and duty cycle.

3.4.15.3 Cooler

Sets the control of the PMT Cooler. It can be set so that it will only decrease the cooler temperature.

Normally it will operate at a maximum output of 70% to reduce the PMT temperature as much as possible.

Can set the setpoint and display the current reading and duty cycle.

3.4.16 Factory

Figure 127 – Factory Child Page

This page contains information unique for the instrument factory setup.

3.4.16.1 Identification

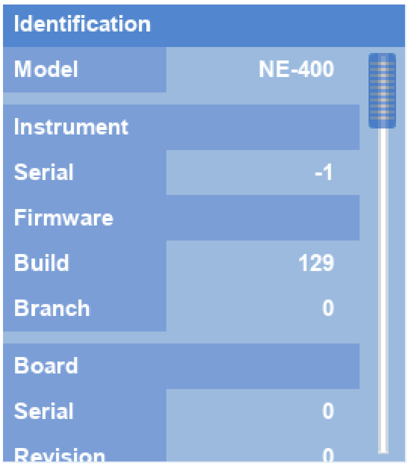


Figure 128 – Identification Panel

The identification information is presented in this panel. The information is grouped by headings and represented by the following fields and buttons:

- Model, identifies the model of the instrument

Instrument

- The serial number allocated to this instrument

Firmware

- The build version of the firmware installed on the instrument
- The branch version of the firmware installed on the instrument

Board

- The serial number of the microprocessor PCA installed in the instrument
- The Revision of the microprocessor PCA installed in the instrument

Run Bootloader button stops the instrument an enters the instruments bootloader

Format EMMC Card button

Rebuild Configuration button

Invoke Watchdog button

- The backlight brightness of the touch screen is adjusted here
- The back scatter shutter radio button enabled/disabled.
- The screen capture radio button enabled/disabled
- The error (Factory use only)
- The counts (Factory use only)

3.4.16.2 Light Source Configuration

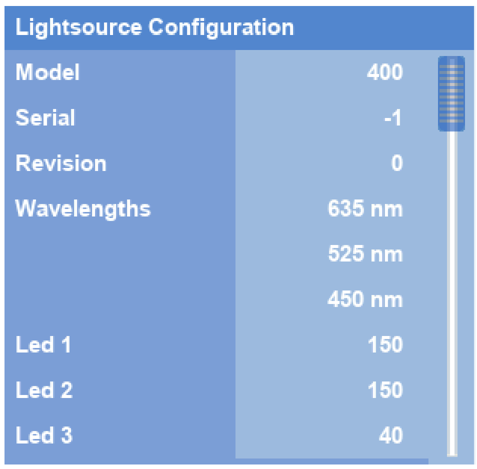


Figure 129 – Lightsource Configuration Panel

This panel has specific information that is stored inside the light source specific to its calibration. These parameters must not be changed unless instructed by the supplier.

3.4.16.3 Edit Button

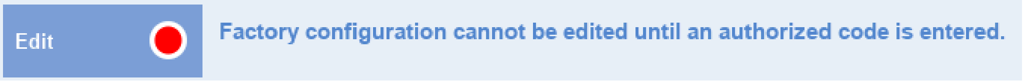


Figure 130 – Factory Child Page Edit Radio Button

The edit radio button is used to edit the details in the light source configuration panel. Using the touch method on the edit radio button will popup a security dialog box. Enter the code to be able to edit the light source configuration.

4. Communications

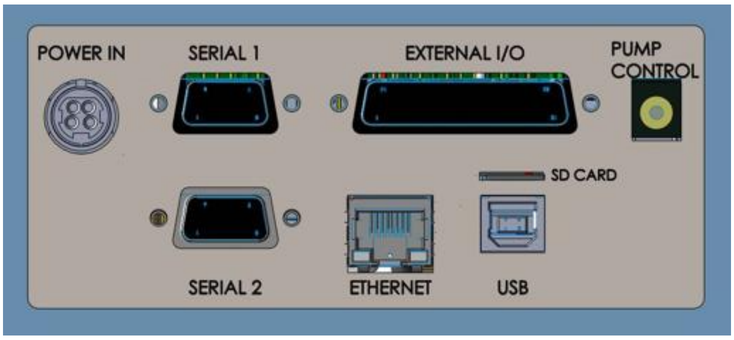


Figure 131 – Communication Ports

The Aurora NE Series Multi Wavelength Nephelometers has a number of different interfaces for communication with other equipment (RS232, USB, 25 pin digital/analog input/output, TCP/IP network and Bluetooth). A demonstration version of Acoem Australasia's Airodis software is included with the instrument, enabling basic data downloads and remote operation from a PC running a supported MS Windows operating system. The full version of Airodis is available separately and includes automated data collection, data validation and complex reporting by multiple users. The following sections of this manual contain details on setting up and communicating with the instrument.

4.1 RS232 Communication

RS232 communication is a very reliable way to access data from the instrument and is recommended for use in connection to a data logger for 24/7 communication. Both RS232 ports are configured as DCE and can be connected to DTE (Data Terminal Equipment such as a data logger or computer).

Both ports support multidrop arrangement (a configuration of multiple instruments connected via the same RS232 cable where the transmit signal is only asserted by the instrument that is spoken to).

For reliable multidrop RS232 communications follow these guidelines:

- Verify that the Serial ID is set to a unique value which is different to the other instruments in the chain.
- All of the instruments in the multidrop chain must have the same baud rate and communication protocol settings. A maximum of 9600 baud rate is recommended.
- The multidrop RS232 cable should be kept to less than three meters in length.
- A 12K ohm terminating resistor should be placed on the last connector of the cable (connect from pin 2 to pin 5 and from pin 3 to pin 5.
- The shielding of the multidrop cable must be continuous throughout the cable.
- The shielding of the multidrop cable must only be terminated at one end. It should be connected to the metal shell of the DB 9-way connector.

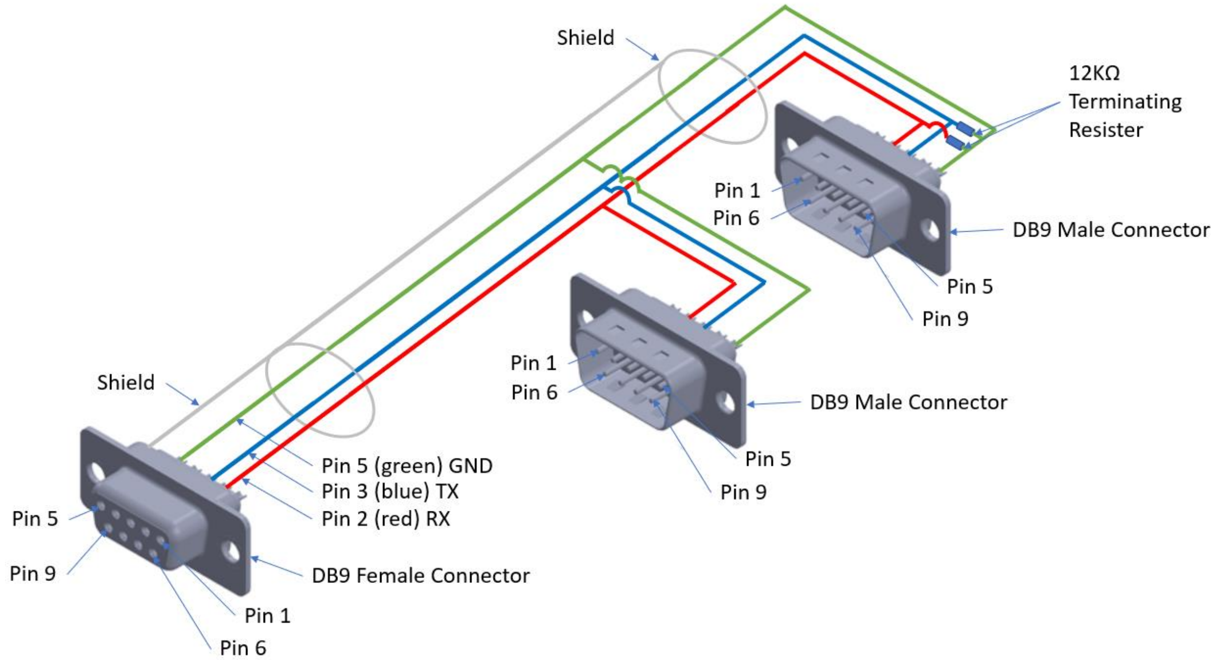


Figure 132 – RS-232 Multidrop Cable Example

4.1.1 Serial Connection Setup

When setting up a serial connection follow the following procedure:

1. Access the Comms page
2. Locate the serial panel

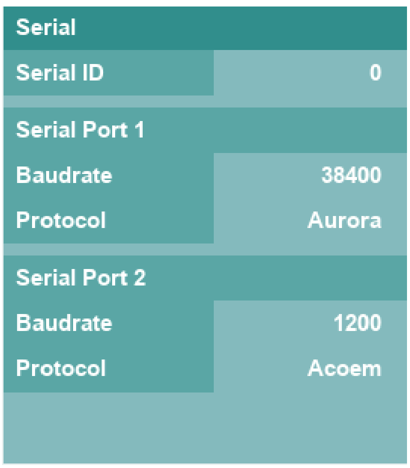


Figure 133 – Serial Connection Setup, Serial Panel

3. Edit the Serial ID if you plan to have several Aurora NE instruments on the one serial port or leave it at 0 as default.
4. Select the baudrate to suit your application.
5. Choose the protocol; Aurora or Acoem. Aurora is legacy and won't give you the full benefits of the Aurora NE Series

6. Connect a standard straight through RS-232 cable male end of the connector into the female port on the instrument.
7. Connect the female end of the RS-232 cable into an available COM port on your selected device.
8. Change the settings on the selected device, they need to match the instrument setup made during steps 3, 4, and 5.

Note: If for any reason any of the details do not match the connection will not work.

The instrument is now ready to receive and send data via the serial port.

4.2 USB Communication

This is ideal for irregular connection to a laptop running Acoem Australasia's Airodis software to download logged data and remotely control the instrument. Due to the nature of USB, this is a less reliable permanent connection as external electrical noise can cause USB disconnection errors on a data logger.

Once the connection has been made between the Aurora NE Series and a PC, windows will automatically install a driver and set up a VSP (Virtual Serial Port). You will need to check device manager to determine the number of the new serial port.

Note: Only the ACOEM protocol is supported for USB communication

4.2.1 Setup Airodis to Communicate with Aurora NE over USB

USB

Below is an example of Airodis setup for a USB connection. Ensure the protocol under the USB heading is set Acoem on the Aurora NE.

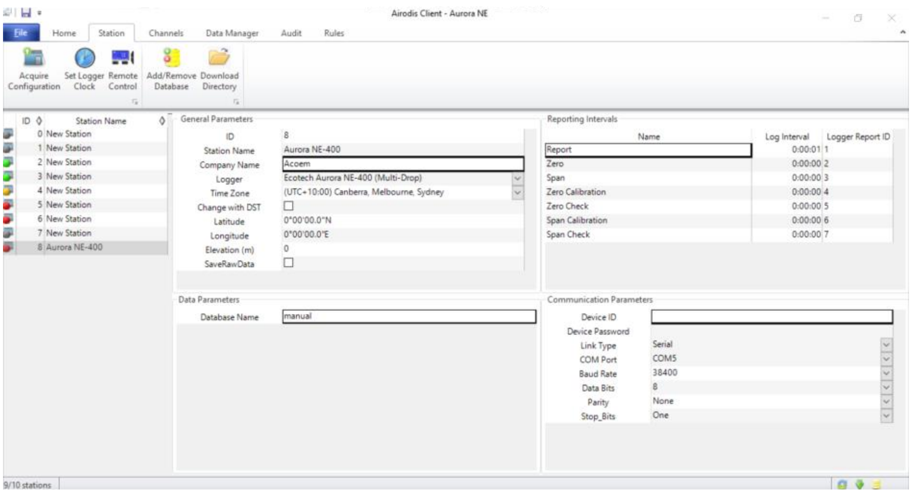


Figure 134 – USB Set-Up (Airodis)

4.3 TCP/IP Network Communication

Instruments can be accessed using a TCP/IP connection. Figure 135 shows examples of some possible configurations for remote access.

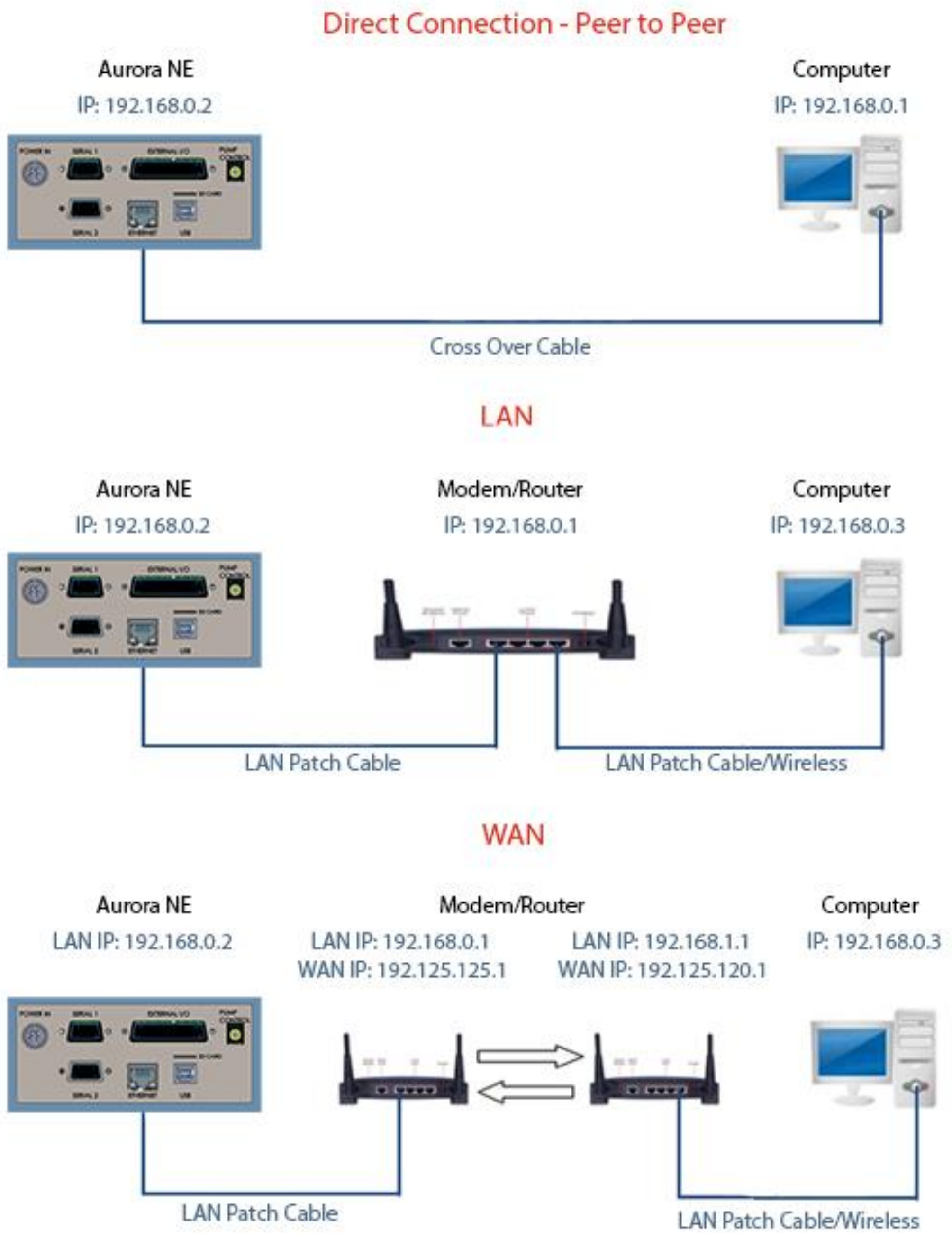


Figure 135 – Example of Typical Network Setups

Note: In Figure 135 all the IP addresses are taken as an example. The WAN IP addresses are normally provided by your ISP. Whereas, the LAN IP addresses can be set manually to any range which is within the subnet of the Modem/Router/switch.

Use a cross-over LAN cable to connect the instrument directly to a computer, or a standard LAN cable for connection to a Modem/Router/Switch as shown in Figure 135. The computer could be connected to the Modem/Router using either CAT5 cable or a wireless connection, but the instrument must be connected using CAT5/6 cable.

4.3.1 Setting Network Port Setup

When setting up a Network connection follow the following procedure:

1. Access the comms page
2. Locate the ethernet panel

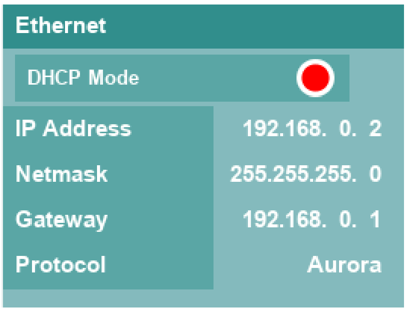


Figure 136 – Example of Ethernet Panel

3. Touch the IP address and using the keypad set the IP address
4. Touch the Netmask and using the keypad set the Netmask
5. Touch the Gateway and using the keypad set the Gateway
6. Choose the protocol; Aurora or Acoem. Aurora is legacy and won’t give you the full benefits of the Aurora NE Series
7. Depending on the network type use a crossover cable for a peer-to-peer connection or patch cable for all other network types

Note: If your IT department uses DHCP to assign IP address, touch the DHCP mode radio button at the top of the ethernet panel an available IP address will be assigned and displayed.

Note: The address assigned using the DHCP mode may change if the port is disconnected or the DHCP mode radio button it toggled. It may also change if the IP address lease time expires.

4.3.2 Setup Airodis to Communicate with Aurora

LAN

Below is an example of Airodis setup for a LAN network. Ensure the IP address is set to the same as on the instrument **Network Menu**.

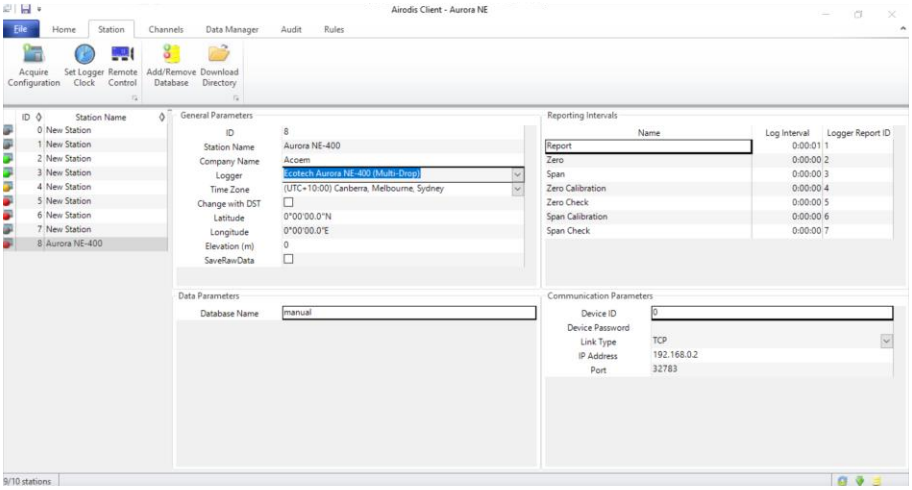


Figure 137 – LAN Network Set-Up (Airodis)

Below is an example of Airodis setup for a WAN network. Ensure the IP address is set the same as on the remote modem/router.

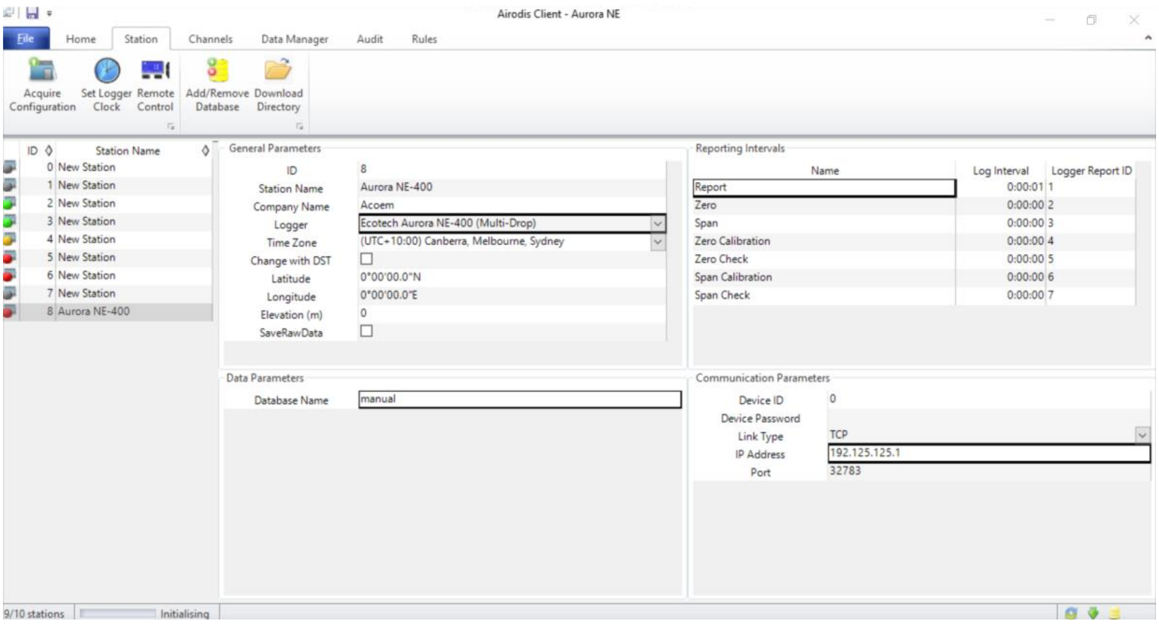


Figure 138 – WAN Network Set-Up (Airodis)

4.4 Analog and Digital Communication

The 25 Pin analog and digital I/O port on the side panel of the instrument sends and receives analog and digital signals to other devices. These signals are commonly used to activate gas calibrators, solenoids or for warning alarms.

4.4.1 Analog Outputs

The instrument is equipped with six analog outputs that can be set to provide 0 – 5 V voltage outputs.
The analog outputs are tied to user selected parameters.

4.4.1.1 Analog Outputs Voltage Calibration

Equipment Required

- Multimeter (set to volts)
- Male 25 pin connector with cable

Procedure TBA

4.4.2 Analog Inputs

The instrument is also equipped with four analog inputs with resolution of 16 bits plus polarity, accepting a voltage between 0 - 5 V. These go directly to the microprocessor and have minimal protection to ensure static/high voltage do not damage the main controller PCA.

4.4.3 Digital Status Inputs

The instrument is equipped with four logic level inputs for the external control of the instrument such as Zero or Span sequences. Each input has a terminating resistor which can be either PULL UP or PULL DOWN. This is set using the jumper JP1 (DIO HI or LO) on the Control PCA.

4.4.4 Digital Status Outputs

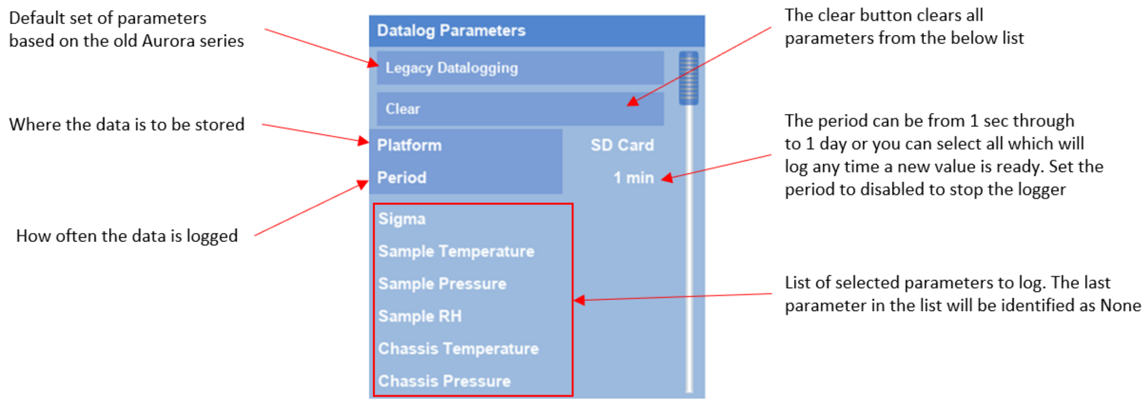
The instrument is equipped with four open drain outputs which will convey instrument status condition warning alarms such as no flow, sample mode, etc.

CAUTION

The analog and digital inputs and outputs are rated to CAT I.

Exceeding 12 VDC or drawing greater than 400 mA on a single output or a total greater than 2 A across the four outputs can permanently damage the instrument and void the warranty.

4.5 Logging Data



When the user receives the instrument from the factory it will have a default set of parameters already setup in the internal data logger. These select few parameters have been chosen for their relevance in assisting in troubleshooting the instrument.

The internal datalogger can have a maximum of 32 parameters selected. Keep in mind that for the NE-300 and NE-400, some of those parameters are lists of numbers rather than a single number (i.e., the Sigma/All/All on a NE-300 can have up to six different numbers: Sigma 450 nm 0°, Sigma 525 nm 0°, Sigma 635 0°, Sigma 450 90°, etc.).

The Aurora NE Series has a logging capacity for more than +10 years of 1 second data.

Data can be stored on the SD card or USB memory stick depending on the platform selected in the datalog parameters panel.

4.5.1 Configure Instrument Internal Logging

This section will assume the parameters have been cleared and you are starting from scratch.

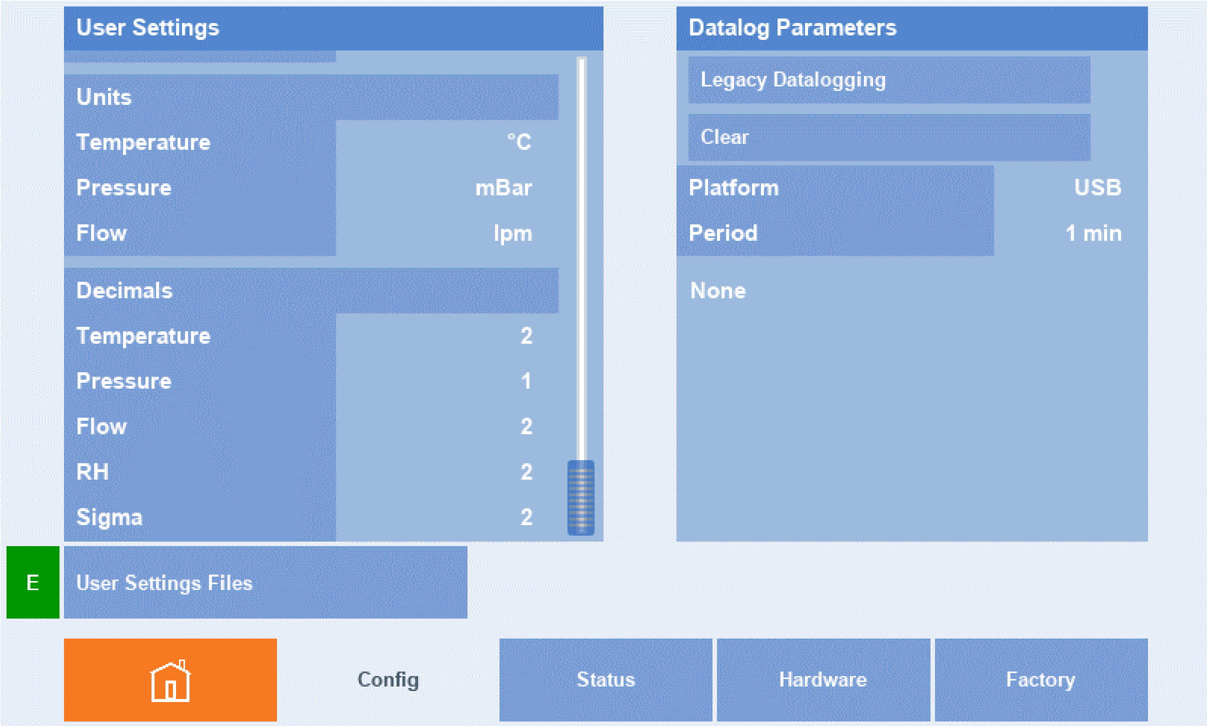


Figure 139 – Cleared Parameter Logging List

In order to log data, the user must follow the following procedure:

1. First specify where the data is to be stored using the platform field

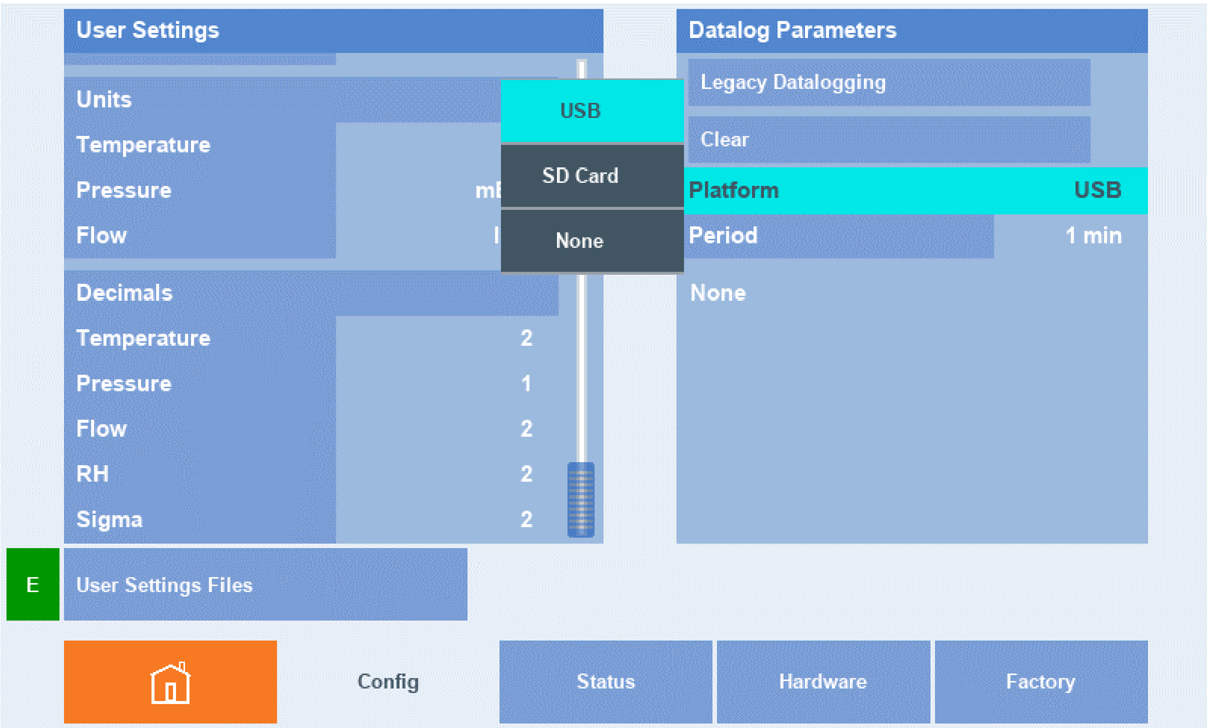


Figure 140 – Data Logger Storage Location

2. Select the period (interval) at which the parameters will be logged using the period field

Figure 141 – Data Logging Interval

3. In the bottom half of the datalog parameters panel is the list of parameters that will be logged ending in none. Touch none to add a new parameter to the list or touch any of the parameters currently in the list to edit them. This will popup a datalog parameter dialog box.

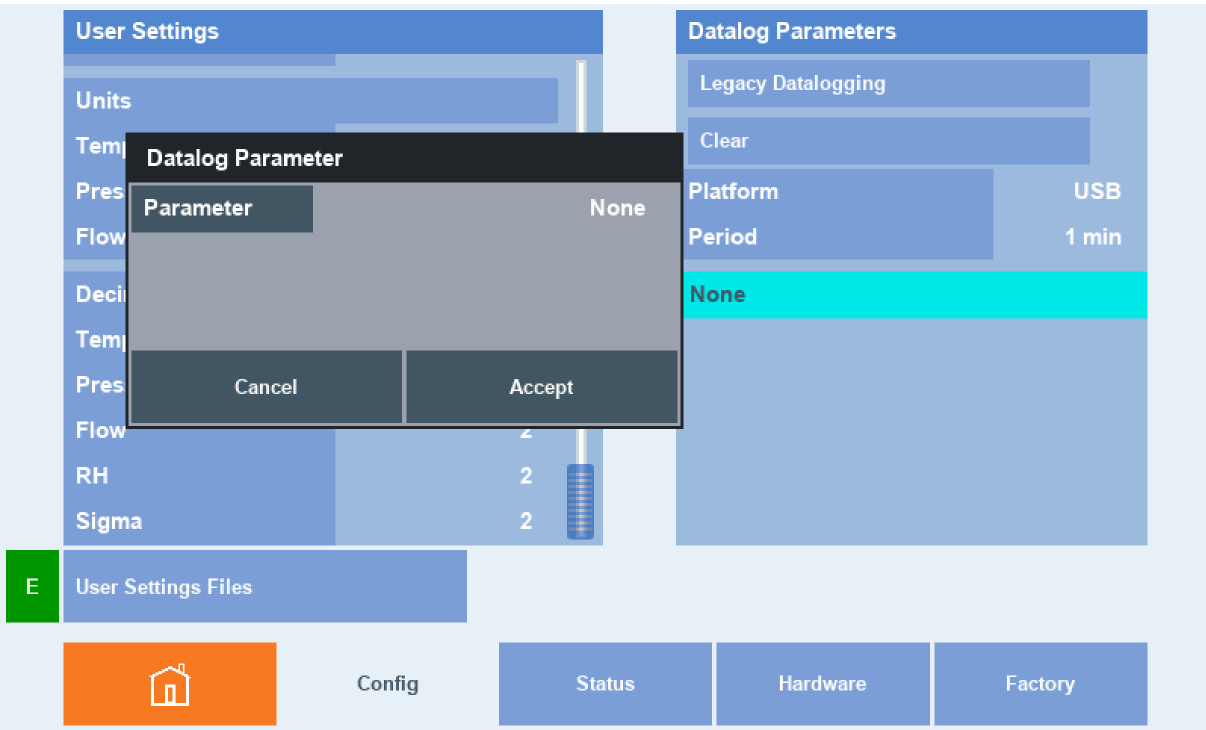


Figure 142 – Datalog Parameter Dialog Box

4. Select none, a list will pop-up with the available parameters to select from

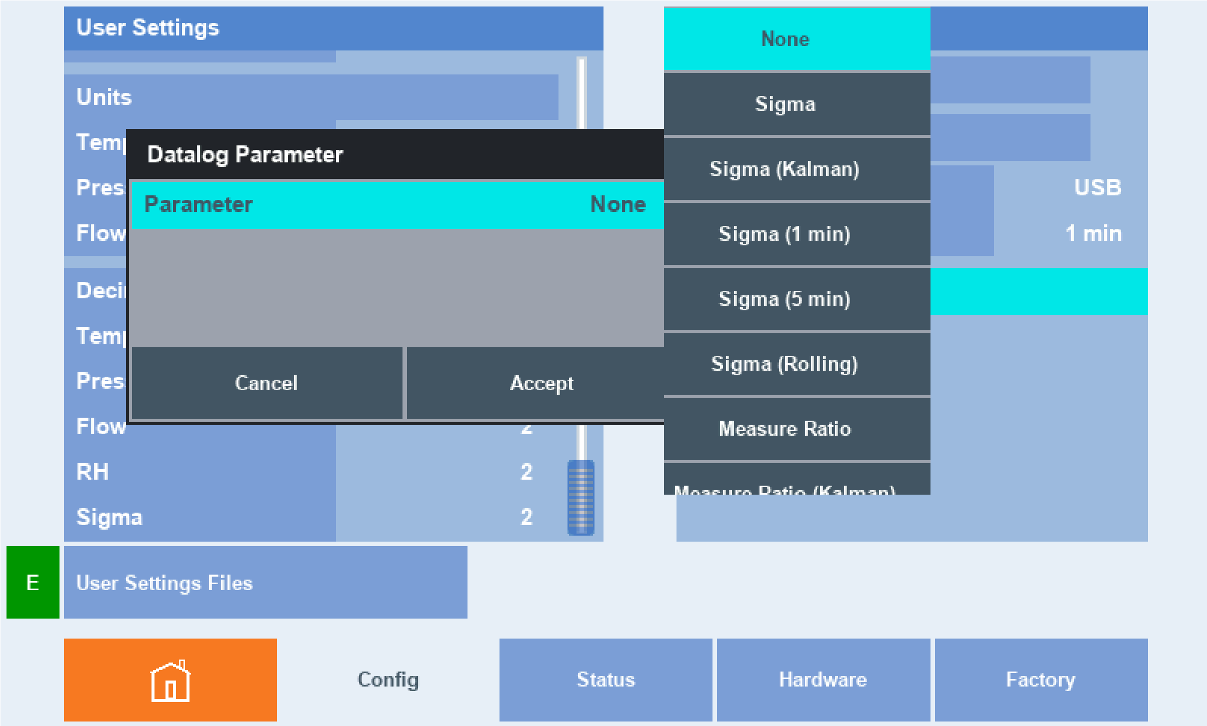


Figure 143 – Datalog Parameter Dialog Box Parameter Selection

5. Select a parameter to log. For this example we will choose Sigma.

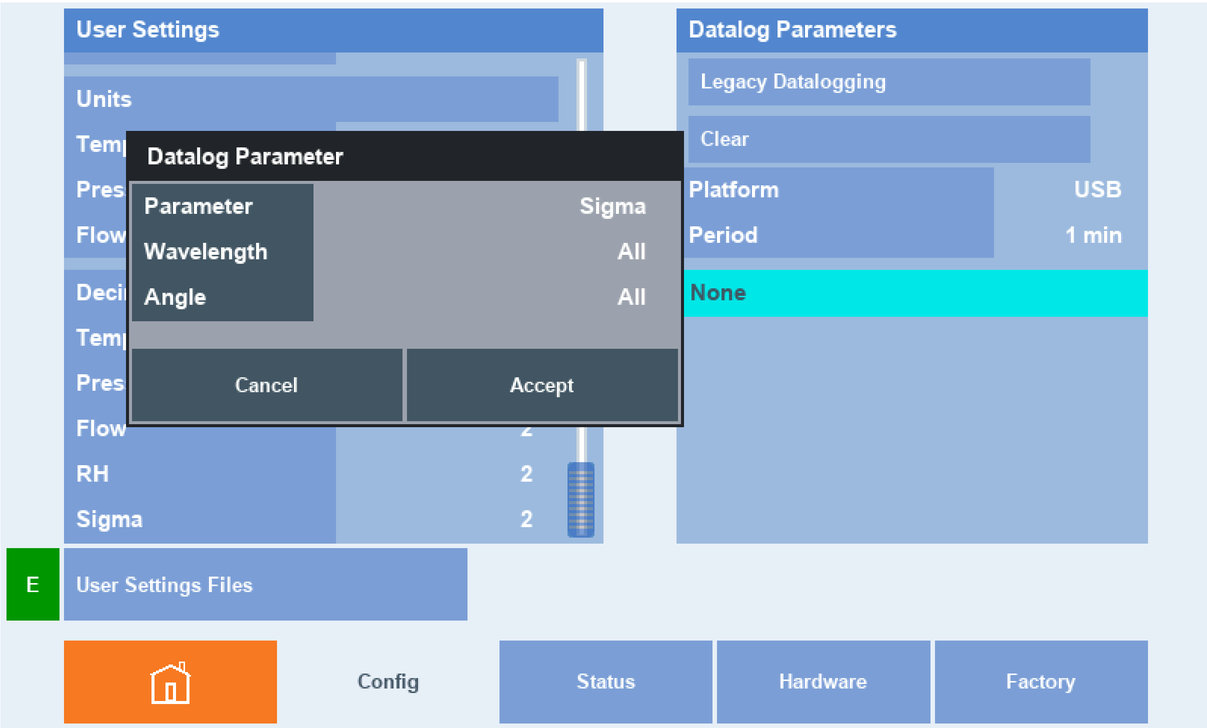


Figure 144 – Example Parameter Selection

6. Press accept to add your selected parameter to the list. Just below the datalog parameters panel a set of buttons will appear; Accept and Cancel. Selecting accept will save the changes and selecting cancel will revert the changes.

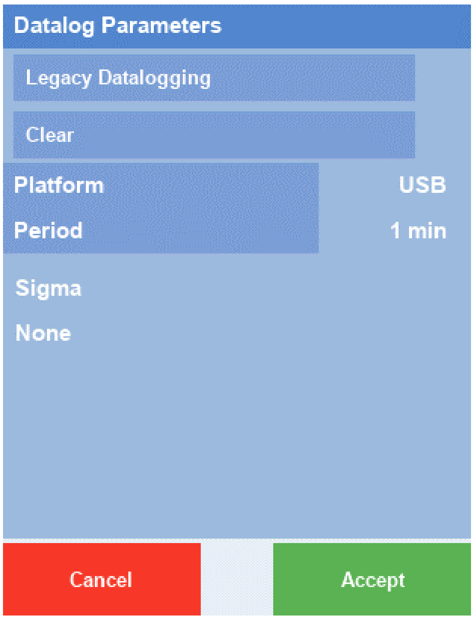


Figure 145 – Accepting Datalog Changes

7. Repeat steps 4- 6 to continue to add new parameters to the list or edit current parameters.
8. Select an existing parameter and change it to none to remove it from the list.

5. Calibration

The following sections describe how to calibrate the span and zero points of the instrument as well as for the system sensors giving a brief overview of the calibration setup.

5.1 Overview

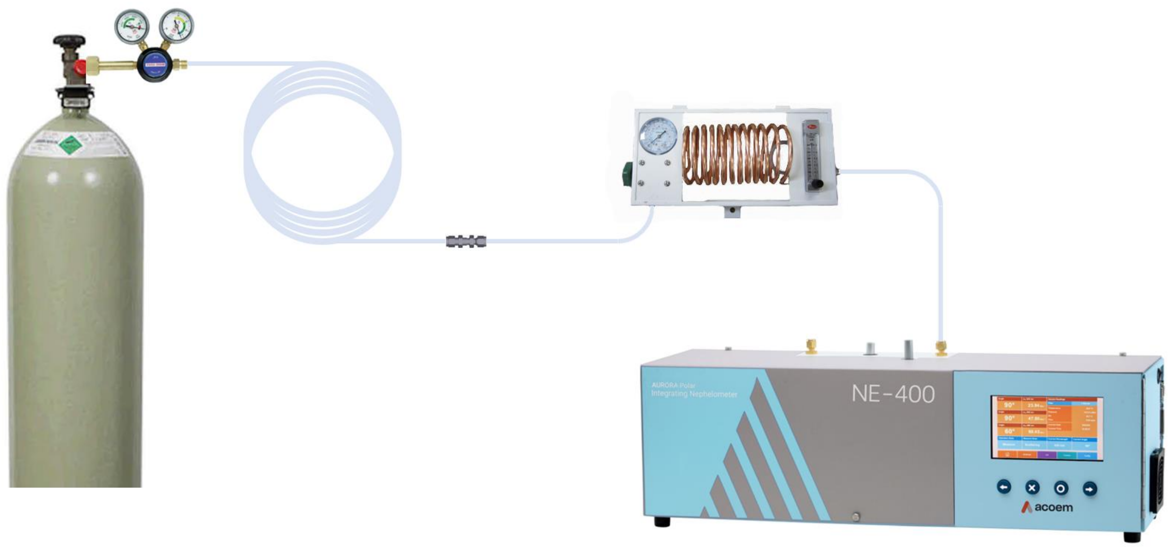


Figure 146 – Gas Delivery System

This section explains the setup of the gas calibration system.

Note: Consult your local regulations for the positioning of the gas cylinder.

When designing your system, you will need to consider the following:

- Overall design of the system for functionality and safety.
  - First and foremost, consult your local regulations for the positioning of the cylinder.
  - In most cases the gas cylinders should be located outside the building and secured to a solid wall.
- Gas Cylinder size, gas and purity and accessories
  - For a rough span check/calibration we recommend using a CO_2 gas cylinder for its known Rayleigh scattering coefficient.
    - For best calibration results we recommend purchasing a gas cylinder of high purity (99.99%) grade CO_2
    - The CO_2 calibration gas cylinder should be fitted with a CO_2 specific brass regulator.
  - For a precision span check/calibration we recommend using FM200 gas cylinder for its known Rayleigh scattering coefficient.

- The FM200 gas cylinder should be fitted with an isolation valve.

Note: Compared to the CO_2 gas the FM200 gas is expensive, care should be taken when calibrating so as not to waste any unnecessarily.

- Gas conditioning and delivery system
  - The system should include at least 1 metre of coiled metal tubing. This is used to bring the gas temperature to room temperature, especially if a refrigerant gas is used.
  - From the metal coil connect tubing to a flow regulator and from the outlet of the flow regulator to the span port on the Aurora NE

Note: An optional Calibration kit (H020331) is available, which provides all the necessary connections to connect the gas cylinder to the Aurora. The recommended gas delivery system is shown in Figure 146.

5.2 Sample Sensor Calibration

5.2.1 Pre Sample Sensor Calibration

To calibrate the sample Temperature/Pressure/Relative Humidity sensor first you need to remove it from the cell body by following this procedure.

1. In the Config - Hardware menu, check that the Heater control is set to off.
2. Switch off the Aurora NE.
3. Open the door and remove the lid. Follow the instructions in Section 2.1 (Opening the instrument)
4. Locate the Pressure, Temperature and Relative Humidity sensor on the front side of the cell, refer to Figure 147

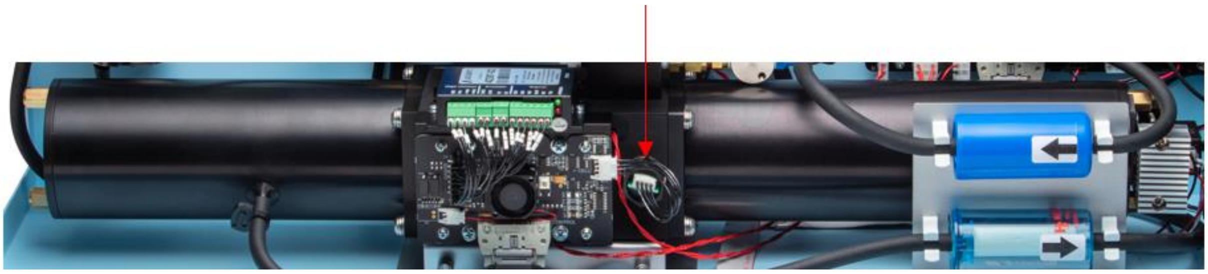


Figure 147 – Location of Temperature Pressure RH Sensor

5. Disconnect the wiring loom from the sensor body, unscrew the sensor from the cell body.

Note: This may take several turns before being able to remove as the threaded body of the Temperature Pressure RH Sensor is quite long.

6. Once the sensor is removed from the cell body reconnect the wiring loom and rest the sensor in the chassis then power up the instrument.

5.2.2 Cell Temperature Calibration

Follow the procedure in section 5.2.1 to remove the sensor before attempting a calibration.

1. Navigate to the Cal page then the sensors child page, on the Environmental Readings panel under the heading Sample select the temperature with the press and hold method.
2. This will popup a menu, select calibrate from the bottom of the menu
3. This will popup a calibration dialog box
4. Place a calibrated temperature reference as close as possible to the sample Temperature Pressure RH Sensor and allow time for the two sensors to stabilise.

Note: Ensure the units of measure setup for the sample Temperature Pressure RH Sensor and the calibrated reference are the same.

5. Select the value field in the calibration dialog box and using the keypad enter the value of the calibrated temperature reference and press enter.
6. The calibration adjustment of the temperature is made automatically select cancel to revert any changes or Accept to confirm and apply the calibration.

5.2.3 Cell Pressure Calibration

Follow the procedure in section 5.2.1 to remove the sensor before attempting a calibration.

1. Navigate to the Cal page then the sensors child page, on the Environmental Readings panel under the heading Sample select the pressure with the press and hold method.
2. This will popup a menu, select calibrate from the bottom of the menu
3. This will popup a calibration dialog box
4. Place a calibrated pressure reference as close as possible to the sample Temperature Pressure RH Sensor and allow time for the two sensors to stabilise.

Note: Ensure the units of measure setup for the sample Temperature Pressure RH Sensor and the calibrated reference are the same.

5. Select the value field in the calibration dialog box and using the keypad enter the value of the calibrated pressure reference and press enter.
6. The calibration adjustment of the pressure is made automatically select cancel to revert any changes or Accept to confirm and apply the calibration.

5.2.4 Cell Relative Humidity Calibration

Follow the procedure in section 5.2.1 to remove the sensor before attempting a calibration.

1. Navigate to the Cal page then the sensors child page, on the Environmental Readings panel under the heading Sample select the RH with the press and hold method.
2. This will popup a menu, select calibrate from the bottom of the menu
3. This will popup a calibration dialog box
4. Place a calibrated RH reference as close as possible to the sample Temperature Pressure RH Sensor and allow time for the two sensors to stabilise.

Note: Ensure the units of measure setup for the sample Temperature Pressure RH Sensor and the calibrated reference are the same.

5. Select the value field in the calibration dialog box and using the keypad enter the value of the calibrated pressure reference and press enter.
6. The calibration adjustment of the pressure is made automatically select cancel to revert any changes or Accept to confirm and apply the calibration.

5.2.5 Post Sample Sensor Calibration

Once the calibration of the sample Temperature/Pressure/Relative Humidity sensor is complete reinstall the sensor following this procedure.

1. Switch off the Aurora NE.
2. Disconnect the wiring loom from the sensor body and screw the sensor back into the cell body.

Note: Ensure the washer is still on the sensor before reinstalling into the cell body.

Note: This may take several turns to tighten as the threaded body of the Temperature Pressure RH Sensor is quite long.

3. Once the sensor is replaced reconnect the wiring loom.
4. Replace the lid back onto the Aurora NE chassis following the instructions in Section 2.1.
5. Close the door and power up the Aurora NE.

5.3 Chassis Sensor Calibration

The chassis Temperature Pressure RH Sensor is not used for any calculations of the readings, so it is not essential that it is calibrated. The Factory calibration is usually sufficient. The sensor is located in the top left had corner of the microprocessor PCA.

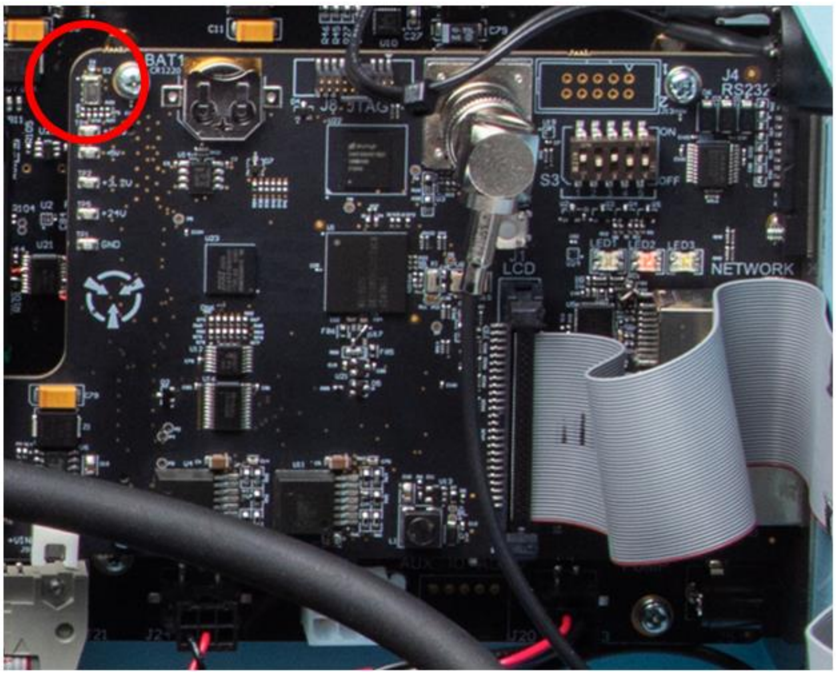


Figure 148 – Location of The Chassis Temperature Pressure RH Sensor

5.3.1 Chassis Temperature Calibration

Follow the procedure to remove the sensor before trying to calibrate the sensor.

1. Navigate to the Cal page then the sensors child page, on the Environmental Readings panel under the heading Chassis select the temperature with the press and hold method.
2. This will popup a menu, select calibrate from the bottom of the menu
3. This will popup a calibration dialog box
4. Place a calibrated temperature reference as close as possible to the chassis Temperature Pressure RH Sensor and allow time for the two sensors to stabilise.

Note: Ensure the units of measure setup for the chassis Temperature Pressure RH Sensor and the calibrated reference are the same.

5. Select the value field in the calibration dialog box and using the keypad enter the value of the calibrated temperature reference and press enter.
6. The calibration adjustment of the temperature is made automatically select cancel to revert any changes or Accept to confirm and apply the calibration.

5.3.2 Chassis Pressure Calibration

Follow the procedure to remove the sensor before trying to calibrate the sensor.

1. Navigate to the Cal page then the sensors child page, on the Environmental Readings panel under the heading Chassis select the pressure with the press and hold method.
2. This will popup a menu, select calibrate from the bottom of the menu
3. This will popup a calibration dialog box
4. Place a calibrated pressure reference as close as possible to the chassis Temperature Pressure RH Sensor and allow time for the two sensors to stabilise.

Note: Ensure the units of measure setup for the chassis Temperature Pressure RH Sensor and the calibrated reference are the same.

5. Select the value field in the calibration dialog box and using the keypad enter the value of the calibrated pressure reference and press enter.
6. The calibration adjustment of the pressure is made automatically select cancel to revert any changes or Accept to confirm and apply the calibration.

5.3.3 Chassis Relative Humidity Calibration

Follow the procedure to remove the sensor before trying to calibrate the sensor.

1. Navigate to the Cal page then the sensors child page, on the Environmental Readings panel under the heading Chassis select the RH with the press and hold method.
2. This will popup a menu, select calibrate from the bottom of the menu
3. This will popup a calibration dialog box
4. Place a calibrated RH reference as close as possible to the chassis Temperature Pressure RH Sensor and allow time for the two sensors to stabilise.

Note: Ensure the units of measure setup for the chassis Temperature Pressure RH Sensor and the calibrated reference are the same.

5. Select the value field in the calibration dialog box and using the keypad enter the value of the calibrated pressure reference and press enter.
6. The calibration adjustment of the pressure is made automatically select cancel to revert any changes or Accept to confirm and apply the calibration.

5.4 Flow Calibration

5.4.1 Internal Pump and Flow Sensor Calibration

The Aurora NE has an internal pump and internal flow sensor with PID feedback control. Flow can be measured as standard or volumetric. The Volumetric flow calculations are done automatically. This procedure calibrates the rate of the flow generated by the internal pump. The following procedure must be performed:

- After a service or repair
- When the external flow check has found the flow to be outside normal range
- When a new pump has been installed
- When the instrument is reset to factory defaults

The below procedure will step the user through a multipoint flow calibration check defining the characteristics of the flow system, the results of which will be used to plot a line of best fit and generate a slope and offset for the calibration.

Equipment Required

- Calibrated Flow Meter (Use a flow meter with a 0 - 10 lpm range set to volumetric flow)

Procedure

1. Navigate to the Config page then to the Hardware child page. Ensure the flow settings on the Installed options panel are set as per the below image.

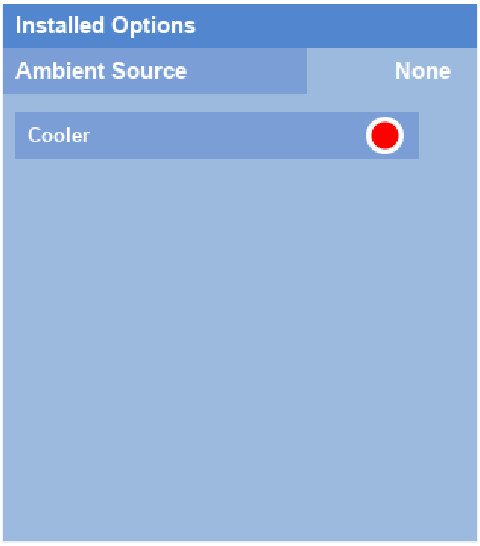


Figure 149 – Internal Pump Flow Settings

2. Connect the outlet of the calibrated flow meter to the sample port of the Aurora NE. Make sure the calibrated flow meter measurement is set to volumetric.

Note: It is advised to use a filter on the inlet of your flow meter for extra protection. Check that there are no kinks in the tubing from the flow meter to the Aurora NE.

3. Navigate to the Cal page. The flow field on the measurement settings panel is where you can change the flow set point for the multipoint flow calibration.

Note: The next set of steps will be used to generate the dataset used to calculate the new slope and offset.

4. Set the flow to 0 lpm allow the system to stabilise ~2 min. Record the value.
5. Set the flow to 3 lpm allow the system to stabilise ~2 min. Record the value.
6. Set the flow to 4 lpm allow the system to stabilise ~2 min. Record the value.
7. Set the flow to 5 lpm allow the system to stabilise ~2 min. Record the value.
8. Set the flow to 6 lpm allow the system to stabilise ~2 min. Record the value.
9. Set the flow to 7 lpm allow the system to stabilise ~2 min. Record the value.
10. Set the flow to 8 lpm allow the system to stabilise ~2 min. Record the value.
11. Plot the data set of expected Vs actual and graph using a XY scatter plot. Add a trendline, linear line of best fit, displaying the equation on the chart but do no set the intercept.

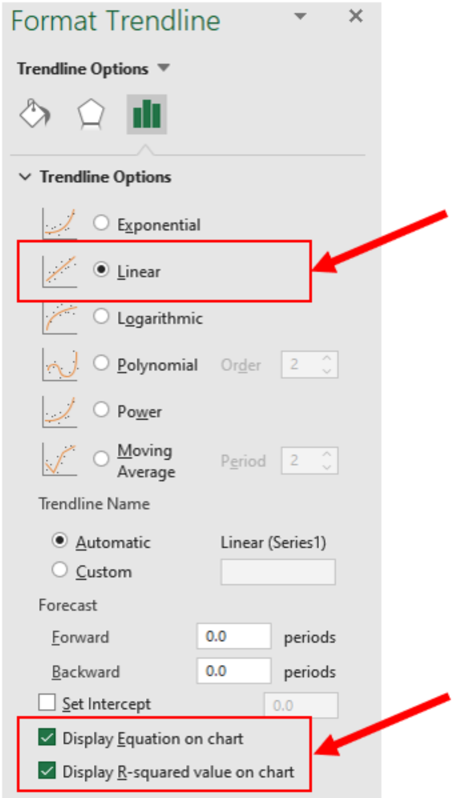


Figure 150 – Trendline Format Settings

Expected	Pre Cal - Actual	% Error	Duty Cycle (%)
8	7.37	7.88	71.4%
7	6.45	7.86	56.0%
6	5.55	7.50	45.0%
5	4.7	6.00	36.0%
4	3.94	1.50	29.37%
3	3.127	-4.23	25.50%

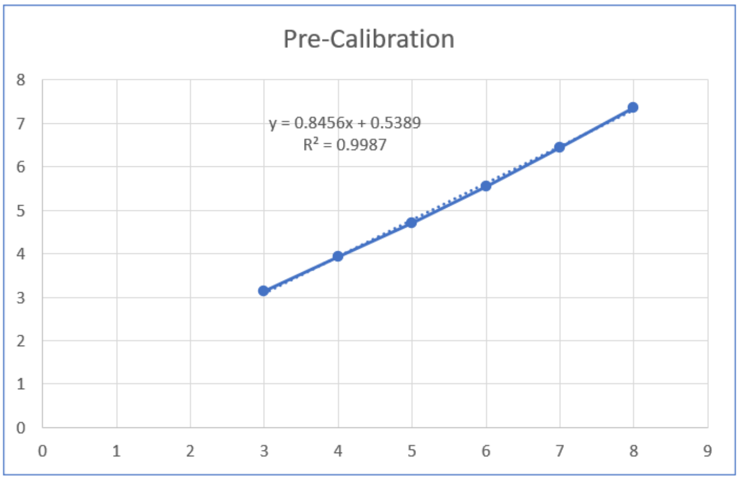


Figure 151 – Example of Pre Calibration Flow Graph

12. The equation on the graph is y=mx+c where m is the slope and c is the offset.
13. Navigate to the sensors child page and on the environmental readings panel press and hold the flow field. A menu will popup select calibrate.
14. This will popup a calibration dialog box. In the slope and offset fields enter the corresponding values obtained from the equation and select accept to apply the calibration or cancel to abort.
15. The 8 lpm flow point should now automatically adjust to match that of the calibrated flow meter. Allow the system to stabilise ~2 min. Record the value.

16. Repeat steps 9,8,7,6,5 and 4 to verify the calibration is correct.

Expected	Post Cal - Actual	% Error	Duty Cycle (%)
8	7.985	0.19	83.14
7	6.977	0.33	63.85
6	5.86	2.33	48.54
5	4.874	2.52	37.74
4	3.973	0.68	31.51
3	3.062	-2.07	22.51

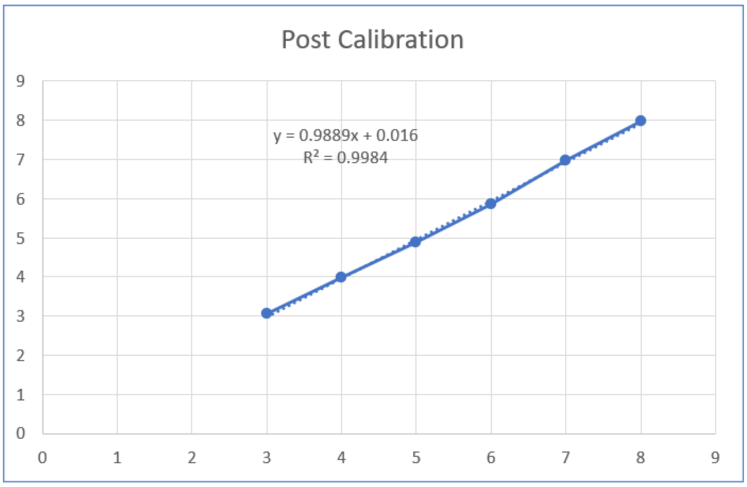


Figure 152 – Example Post Calibration Flow Check

5.4.2 MFC Option Calibration

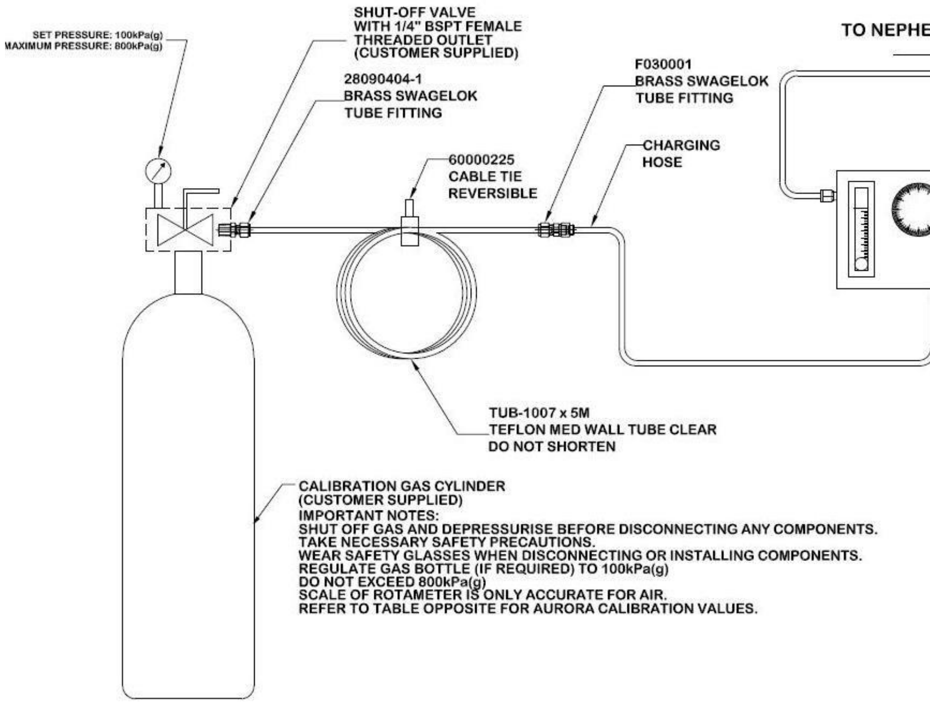
TBA

5.5 Full Calibration (Span and Zero)

The full calibration performs a two-point calibration on the Instrument. The span point uses calibration gas, the zero point use internally filtered particle free air taken from the sample inlet. A full calibration is one in which both the span and zero points on the calibration curve will be modified. Due to the high stability of the instrument, this type of calibration only needs to be performed approximately every 3 months using calibration gas. Typically, FM200 is used for the full calibration. A full calibration can be performed as follows once the setup is completed.

5.5.1 Connecting the Calibration Gas

- Consult your local regulations for the positioning of the gas cylinder.
- In most cases the gas cylinders should be located outside the building and secured to a solid wall.
- The Calibration gas should be high purity 99.99% gas for accurate calibration.
- The calibration gas cylinder should be fitted with a regulator and flow meter.
- It should also include at least 1 metre coiled line to bring gas temperature to room temperature, especially if a refrigerant gas is used.
- ACOEM can supply an optional Calibration kit (H020331) which provides all the necessary connections to connect the gas cylinder to the Aurora. The recommended gas delivery system is shown below.
- Connect your calibration gas to the “span gas” port on the top of the Aurora. No connection is required for the Zero Air as the Aurora has its own internal filters



AURORA NEPHELOMETER CALIBRATION TABLE

FLOWMETER SCALE (INDICATED) l/min OF AIR	FM200 (ACTUAL) l/min	CO2 (ACTUAL) l/min
1	0.6	0.9
2	0.9	1.7
3	1.3	2.5
4	1.8	3.3
5	2.2	4.2

5.5.2 Setup

Navigate to the Cal page, make sure that the following calculation factor settings on the calibration settings panel, are set before scheduling or manually starting a calibration. They will all impact the overall calibration calculation.

1. **Calibration Gas**: Set to the type of calibration gas you are using. Generally CO_2 or FM200.

2. **Purge**: Set the calibration purge time (in minutes) required to complete each calibration step (span or zero). Typically set to 10 minutes for a good calibration with 2 angles enabled. Set to 20 minutes if 18 angles are enabled.

3. **Filter:** For best results set the filter type to Kalman.

5.5.3 Procedure

Navigate to the Cal page then the Schedule child page, under the full calibration panel, press the manual button. Press the accept button to confirm your selection to commence the calibration. This will instantly start a full calibration with the zero first and then the span gas.

If you haven't already done so open the valve on your calibration gas. When the calibration is complete it is advised to close the cylinder shutoff valve.

5.5.4 Verification

When the calibration is complete, navigate to the Cal page then the Checks child page. The results of the calibration will be under Zero adjust and Span Calibrate.

5.6 Precision Check (Span and Zero)

The zero check and span check are a single-point precision check on the Instrument. The span point uses calibration gas, the zero point use internally filtered particle free air taken from the sample inlet. The calibration curve will not be modified at any point during this process. Even though this is a highly stably instrument it is advised for long duration measurements that a nightly span and zero precision check be carried to ensure the validity of the data captured over the period since the last valid calibration.

Note: Refer to your local standard for compliance requirements.

Typically CO_2 is used for the precision checks. The setup of the calibration system is the same as a full calibration but the CO_2 cylinder shutoff valve is left open.

There are two methods to start a precision check, scheduled and manual. The following sections cover the two different methods.

5.6.1 Scheduled

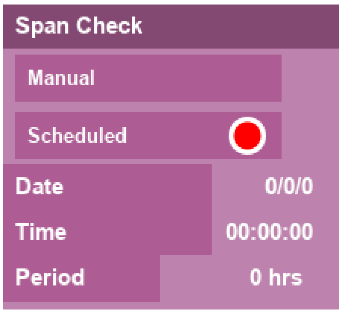


Figure 153 – Example of Scheduled Span Check

To activate the scheduled span or zero check the associated panel must have the following fields with valid conditions for it to activate:

- The Scheduled radio button need to be green (active).
- The Date needs to be some time in the past.
- The Time needs to match the system clock for a daily period or the time needs to be some time in the past for hourly period
- The period defines how many times the precision check will occur once all the conditions met.

Note: If a field with a radio button is red, it is disabled. If it is green, it is enabled. Touching the radio button will alternate its state.

Once all the conditions listed above are met on the associated panel the Aurora NE will behave as if the user has touched the manual button and activate the precision check sequence.

5.6.2 Manual

Pressing the manual button will bring up a confirmation dialog box.

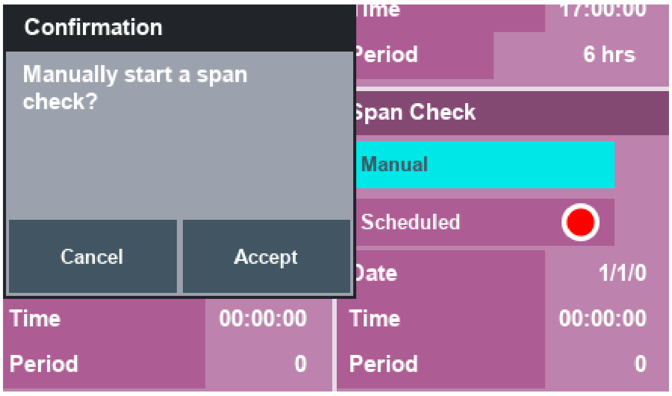


Figure 154 – Manual Span Check Confirmation Dialog Box

Selecting Cancel will revert the calibration without any effect; selecting Accept will proceed to start the precision check sequence.

5.6.3 Precision Check Sequence

When the precision check sequence is started the calibration alert icon will appear on the left of the active page.

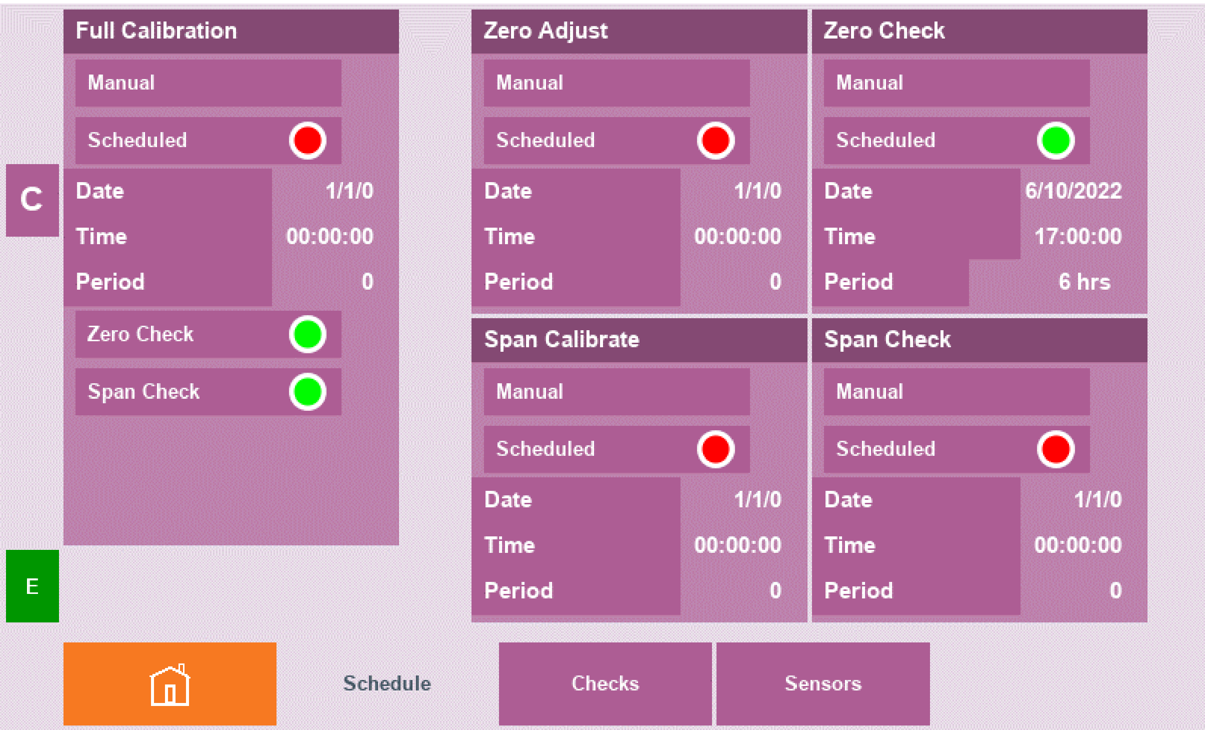


Figure 155 – Manually Started Span Check

Touching the calibration alert will popup a manual span or zero check dialog box. The dialog box presents the current state and time remaining in seconds. It also has a stop calibration button.

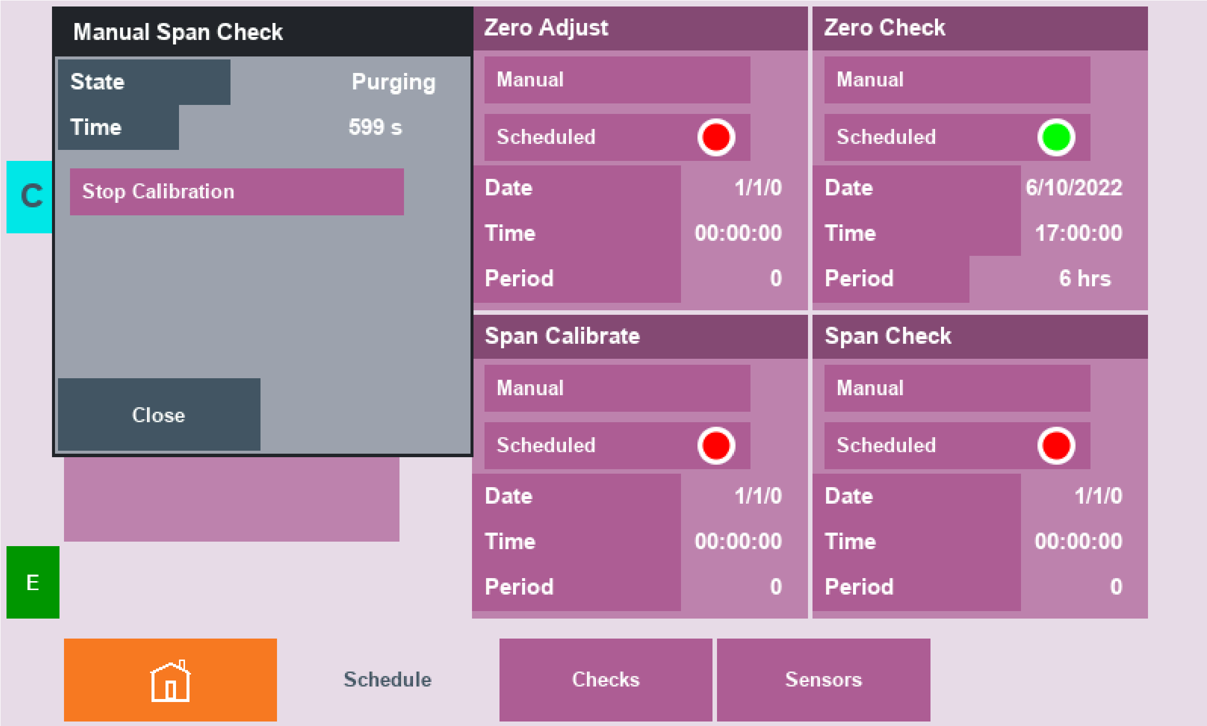


Figure 156 – Example of Manual Span Check

The zero or span precision check sequence is defined by the settings on the cal page calibration settings panel and follows the following sequence:

1. Changing valves from sample to span or zero
2. Purging the cell with span or zero based on the purge time from the calibration setting panel
3. Measuring for a window of N cycles where N is based on the window field from the calibration setting panel. Each cycles duration will depend on the number of angles selected. (e.g., It will take around 15 seconds between cycles for 18 angles)
4. Changing valves from span or zero back to sample
5. Finishing with a sample purge based on the purge time from the calibration setting panel

Pressing the stop calibration button at any time during this process will popup a confirmation dialog box, selecting cancel will close the dialog box and continue on with the calibration, selecting accept will change source valves back to sample and change the state to complete and run a purge.

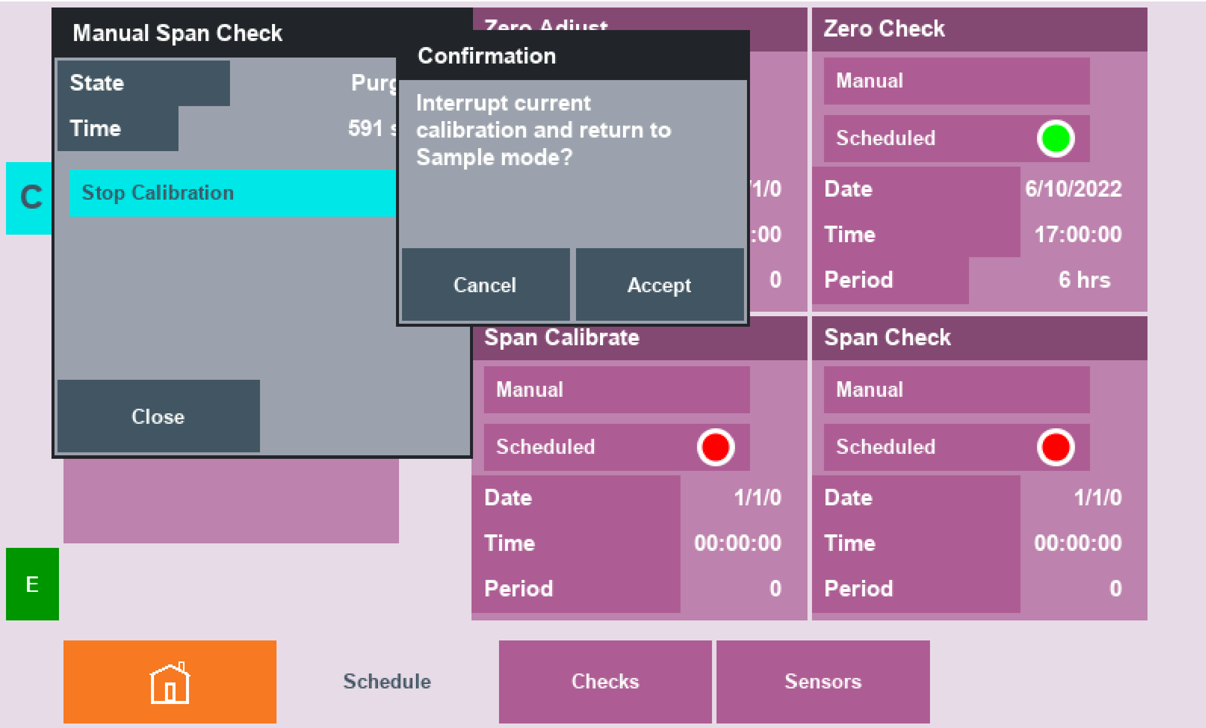


Figure 157 – Stop Calibration Confirmation Dialog Box

Note: Pressing stop calibration again will override the purge state and completely stop the calibration.

5.7 Zero Adjust and Span Calibrate

The zero adjust and span calibrate behave the same as the zero or span precision checks but they will adjust the calibration.

6. Service

6.1 Additional Safety Requirements for Service Personnel

In addition to Safety Information stated previously, service personnel are also advised of the following:

- Documentation must be consulted in all cases where caution symbol are marked, in order to find out the nature of the potential hazards and any actions which have to be taken to avoid them. Refer to Table 1 – Internationally Recognised Symbols.
- Do not energise the instrument until all conductive cleaning liquids, used on internal components, are dried up.
- Do not replace the detachable mains supply cord with an inadequately rated cord. Any mains supply cord that is used with the instrument must comply with the safety requirements (250 V/10 A minimum requirement).

6.2 Maintenance Tools

To perform general maintenance on the Aurora NE Series the user may require the following equipment:

- Customizable Test Equipment Case PN: H070301
- Digital Multimeter & Leads (DMM) PN: E031081 & E031082
- Barometer PN: E031080
- Thermometer & Humidity Probe PN: E031078 & E031079
- Flow Meter (Select Range)

  Range: 0 - 20 slpm
- Computer/Laptop and Connection Cable for Diagnostic Tests
- 1.5 mm Hex Key
- Span Gas Source
- General Hand Tools
- Phillips Head Screwdrivers.
- Flat ended Screwdriver.
- Adjustable wrench.
- Black cloth or plastic bag.
- Bright LED Torch.
- CRC CO Contact Cleaner.
- Lint and grease free tissues or cloth.

6.3 Maintenance Schedule

The maintenance intervals are determined by compliance standards that differ in various regions. The following is recommended by Acoem Australasia as a guide. Compliance with local regulatory or international standards is the responsibility of the user.

Table 6 – Maintenance Schedule

Interval *	Task Performed	Section
Nightly	Zero Check	5.6
Weekly	Precision Check	5.6
3 Monthly	Full Calibration	5.5
	Clock Check	
6 Monthly	Inspect Sample Filter	
	Inspect Zero Filter	
	Inspect Sample Inlet	
	Measurement Cell Cleaning	
	Leak Check	
Yearly	Zero Noise Check	
	Replace Battery	
	Clean Pneumatics	
	Clean Optical Chamber	
	Check Light Source	
	Calibrate Cell Sensor	

* Suggested intervals for maintenance procedure are a guide only and may vary with sampling intensity and/or environmental conditions. Refer to your local regulatory standard for your personalised maintenance schedule.

6.4 Maintenance Procedures

6.4.1 Zero Check

To ensure the instrument is running appropriately precision checks must be performed every week. A precision (calibration) check involves performing a span and zero calibration check (which may have been performed automatically over night or manually), then navigating to Home page –> Schedule page –> Checks child page and checking the values.

1. The Last zero should be 0 ±1 Mm^{-1}

2. The Last span should be within ±5% of span value.

6.4.2 Precision Check

Refer to Section 5.6.

6.4.3 Clock Check

It is important to check the clock and synchronise it with a reference to ensure data, event logs and schedules occur accurately.

The date and time can be viewed from the home page on the sample readings panel.

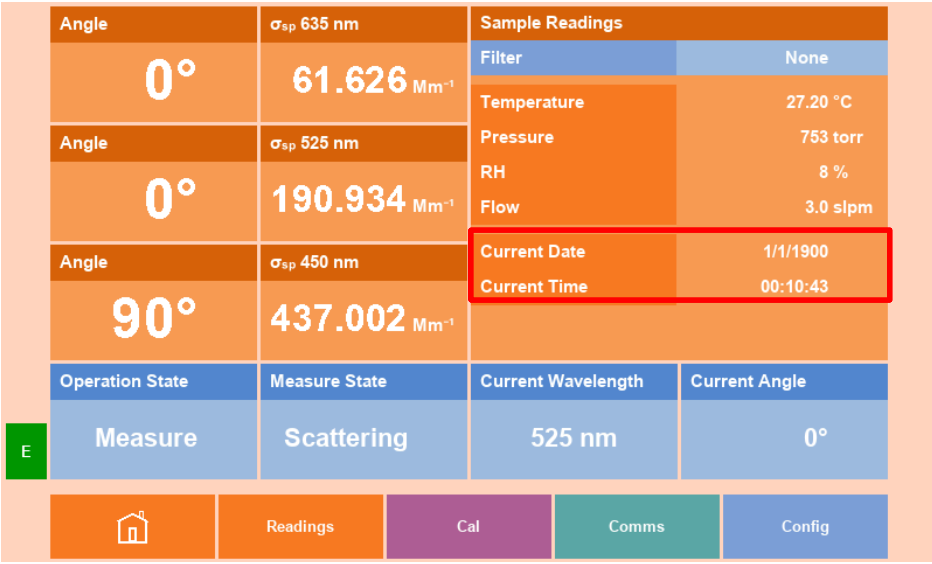


Figure 158 – Location of Date and Time

To adjust the clock navigate to the config page. On the User Settings panel under the heading Clock there are two fields; current date and current time. Touch either of these fields and using the keypad change the date or time respectively.

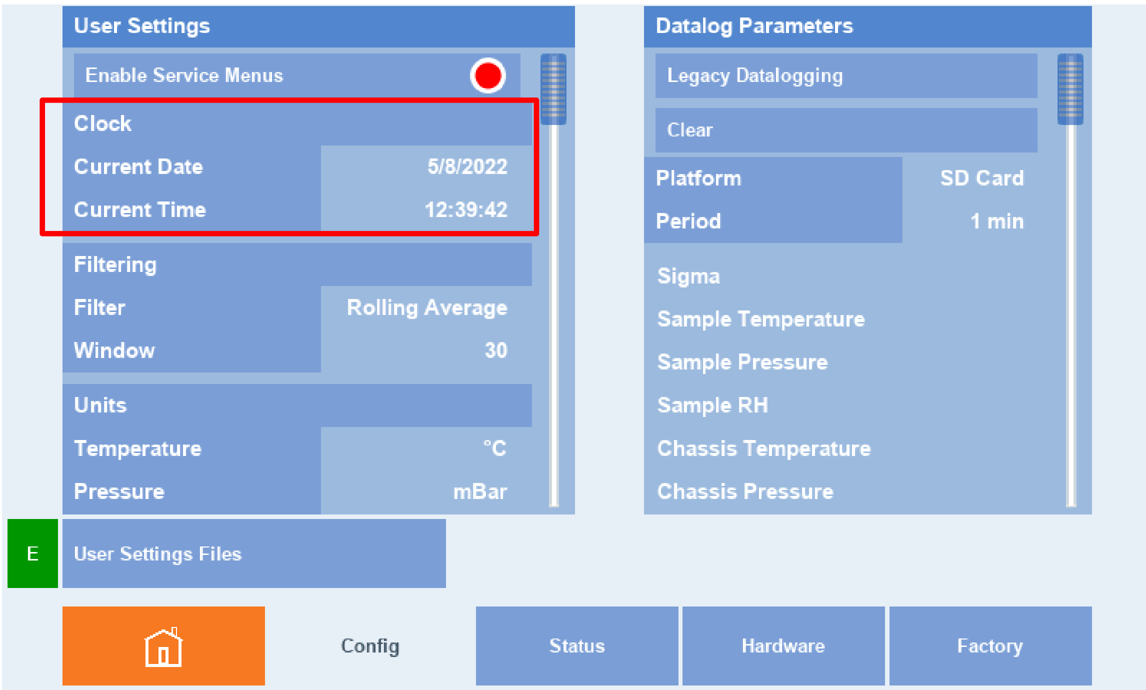


Figure 159 – Date and Time Adjustment

6.4.4 Enclosure Cleaning

The enclosure can be cleaned using clean dry oil free compressed air or a vacuum with a detailing brush connection.

1. If using compressed air, take the instrument to an open area outside.
2. Ensure all ports are caped or blocked
3. Remove the lid and use the compressed air to blow the dust from the instrument, going from right to left.

6.4.5 Pump Filter Replacement

The pump filter sits inside the chassis just below the brass fitting on the exhaust port. It acts as a muffler for the internal pump. To replace the filter follow the below procedure:

1. Loosen the 1/4" brass nut inside the chassis (bottom of brass fitting) until the DFU is free to move. This should only take a couple of turns to free the DFU.
2. Pull the filter down to remove it from the fitting.
3. On the lower half of the filter remove the black tubing by first releasing the hose clamp (the hose clamp can be released by pushing the two halves in opposite directions) and then pulling off the tubing.
4. Correctly dispose of the DFU and replace with a new DFU.
5. Ensure the hose clamp is sitting on the black hose before connecting to the new DFU. Secure the clamp by pressing the two halves together allowing the teeth to ratchet closed.
6. Insert the other end of the DFU back into the brass fitting until the end of the DFU hits the tube stop.
7. Hand tighten the 1/4" brass nut until the DFU is firmly in place and won't easily pull out. This half of the DFU is held in place by a Teflon ferule. Do not over tighten the brass nut or you will deform and damage the Teflon ferule.

6.4.6 Zero Filter Replacement

The zero filter sits inside the chassis and is easily accessible using the chassis door. Its inline flow path is between the sample ball-valve and the zero solenoid. It is mounted to the filter bracket just inside the chassis door. This filter is 99.99% efficient at filtering particulate matter. It is used to produce the particulate fee zero air for the zero precision check and zero adjust. To replace the filter follow the following steps:

1. Note the orientation of the disposable filter. There should be a sticker with a large black arrow on a silver background pointing away from the PMT.
2. Remove the filter, using one had to support the top left corner of the bracket and the other hand to pull the filter on the supported side. The black tube will pop out of the bracket along with one side of the filter.
3. Repeat the above step for the right hand side.
4. With the filter now free from the bracket, hold it in one hand and with the opposing hand remove the black tubing by pulling slowly but firmly, as the tubing begins to give way don't pull as hard.
5. Correctly dispose of the DFU and replace with a new DFU.

6. Holding the new DFU in one hand reconnect the black tubing to each end.
7. Aling the DFU with the bracket as it was before you took it out. Using two hands support the back of the bracket while using your thumbs to push the DFU into the clips.

6.4.7 Exhaust Filter Replacement

The Exhaust filter sits inside the chassis and is easily accessible using the chassis door. Its inline flow path is between the exhaust of the cell and the inlet on the internal pump. It is mounted to the filter bracket just inside the chassis door. This filter is 95% efficient at filtering particulate matter. It is used to protect everything in the flow path after the cell such as valves and flow sensor and internal pump. To replace the filter follow the following steps:

1. Note the orientation of the disposable filter. There should be a sticker with a large black arrow on a silver background pointing towards the PMT.

Note: The flow direction indicated on the DFU is opposite to how the device is intended to be used. Be sure to follow the stickers flow direction not the printed direction. We do this so that the particulate matter is clearly visible to the user for serviceability.

2. Remove the filter, using one had to support the top left corner of the bracket and the other hand to pull the filter on the supported side. The black tube will pop out of the bracket along with one side of the filter.
3. Repeat the above step for the right hand side.
4. With the filter now free from the bracket, hold it in one hand and with the opposing hand remove the black tubing by pulling slowly but firmly, as the tubing begins to give way don't pull as hard.
5. Correctly dispose of the DFU and replace with a new DFU.
6. Holding the new DFU in one hand reconnect the black tubing to each end.

Aling the DFU with the bracket as it was before you took it out. Using two hands support the back of the bracket while using your thumbs to push the DFU into the clips.

6.4.8 Measurement Cell Cleaning

The below procedure outlines the steps required to clean the measurement cell.

1. Switch off the Aurora NE.
2. Open the door and remove the lid. Follow the instructions in Section 2.1 (Opening the instrument)
3. Unplug the light source ribbon cable connected to the bottom side of the light source by placing your hands on top of the cell body and using your thumbs to evenly press each side of the cable release tabs outwards, ejecting the ribbon cable.

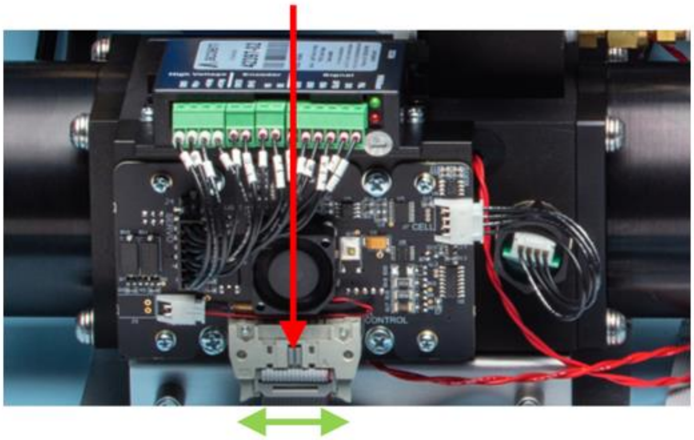


Figure 160 – Ejecting Light Source Ribbon Cable

4. Unplug the Pressure, Temperature and Relative Humidity sensor on the front side of the cell by gently but firmly pulling the cable.

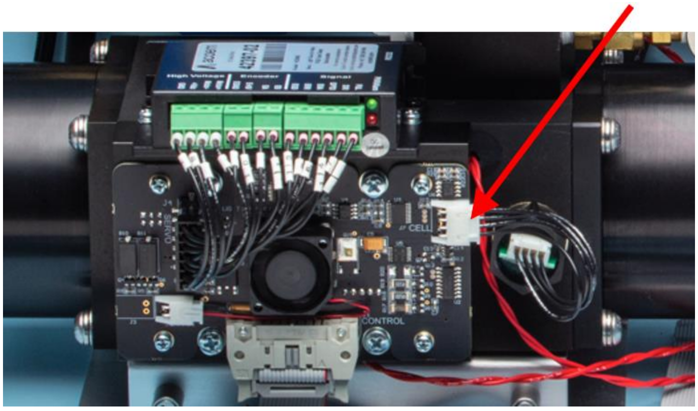


Figure 161 – Location of Pressure, Temperature and Relative Humidity Sensor Cable

5. Remove the four M4 screws securing the light source to the cell body.

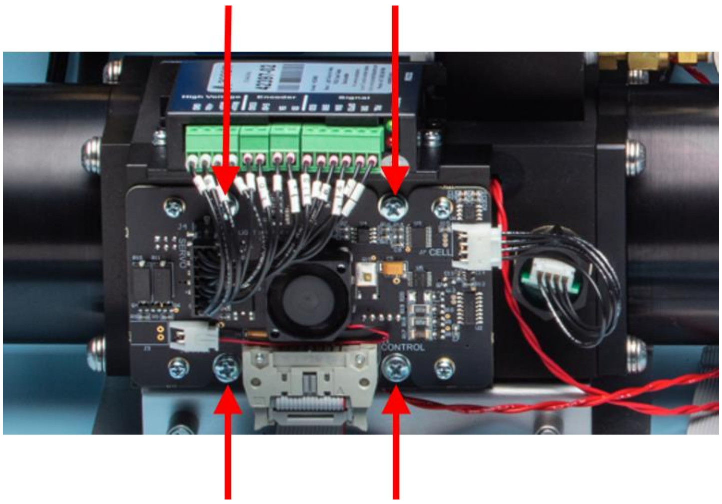


Figure 162 – Location of Light Source Screws

6. Even with the four screws removed the light source will be held in place only by the O-ring seal. Gently break the seal and gently pull the light source straight out. Great care should be taken to prevent any damage to the backscatter shutter from catching on the top of the cell opening. Place the removed light source in a safe place resting it upside down on the servo motor controller side.

Figure 163 – light Source Resting Position

Note: Ensure the O-ring within the light source is not lost or misplaced

7. Inspect the surface area of the light source that sits inside the cell. Check the paint quality and overall condition as well as the integrity of the backscatter shutter. If dusty lightly run the microfiber glove over the light source window and backscatter shutter until clean.

Note: Using a bright torch can really help identify dusty areas.

8. Using a torch and a microfiber glove remove the dust from the inside of the cell paying special attention to the bottom right hand side of the cell body.

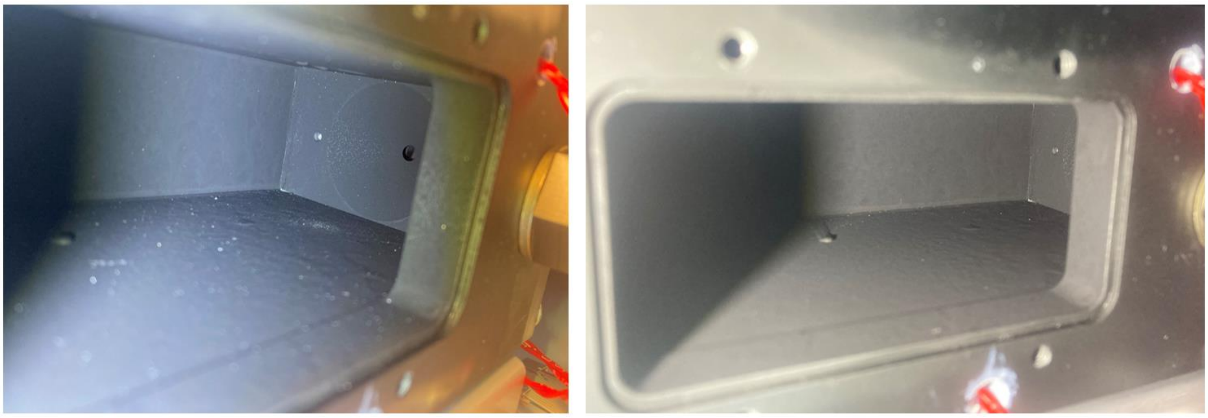


Figure 164 – Cell Body Clean Before and After

Note: Do not leave finger prints or any residue within the cell.

9. Inspect the integrity of the O-ring, looking for cracks, damage to the sealing face surface, and dust. Replace if required.

10. Ensure the O-ring is sitting correctly around the light source housing and carefully replace the light source (servo motor controller site up) back into the cell body. Care needs to be taken not to catch the backscatter shutter on the cell body or scratch any surface of the two assemblies.

Note: Placing dowels into the screw holes can help guide the light source into place minimising any damage. Once in place remove the dowels and replace the M4 screws (flat washer - spring washer – M4 screw in that order).

11. Place the screws in finger tight, inspect the assembly to ensure no wires are pinched and the assembly is sitting flush. Then tighten the screws gradually and evenly in a crisscross pattern until tight.
12. Reconnect the light source ribbon cable to the bottom side of the light source by first placing the cable into the connector and then using your hands on top of the cell body use your thumbs to evenly press the centre of the cable (green arrows). The release tabs will automatically lock into place with a solid click for each side.

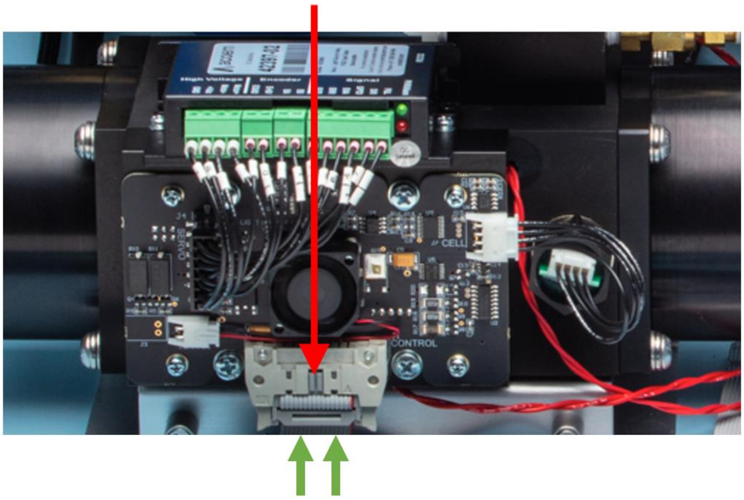


Figure 165 – Connecting Light Source Ribbon Cable

13. Reconnect the Pressure, Temperature and Relative Humidity sensor on the front side of the cell by gently but firmly pushing the cable into the connector.
14. Always perform a leak check and full calibration after removing the light source.

6.4.9 Optical Chamber Cleaning

Cleaning of the optical chamber requires addressing the following sub assemblies:

PMT Assembly

Reference Shutter Assembly

Light Source Cleaning

Light Trap Mirror

The following sections cover the procedures for removing the optical cell and outlines the steps required to gain access to the internal assemblies mentioned above for optical chamber cleaning.

6.4.9.1 Optical Chamber Removal

1. Switch off the Aurora NE.
2. Open the door and remove the lid. Follow the instructions in Section 2.1 (Opening the instrument)
3. Remove the tubing from the following points on the optical cell and the sample manifold.

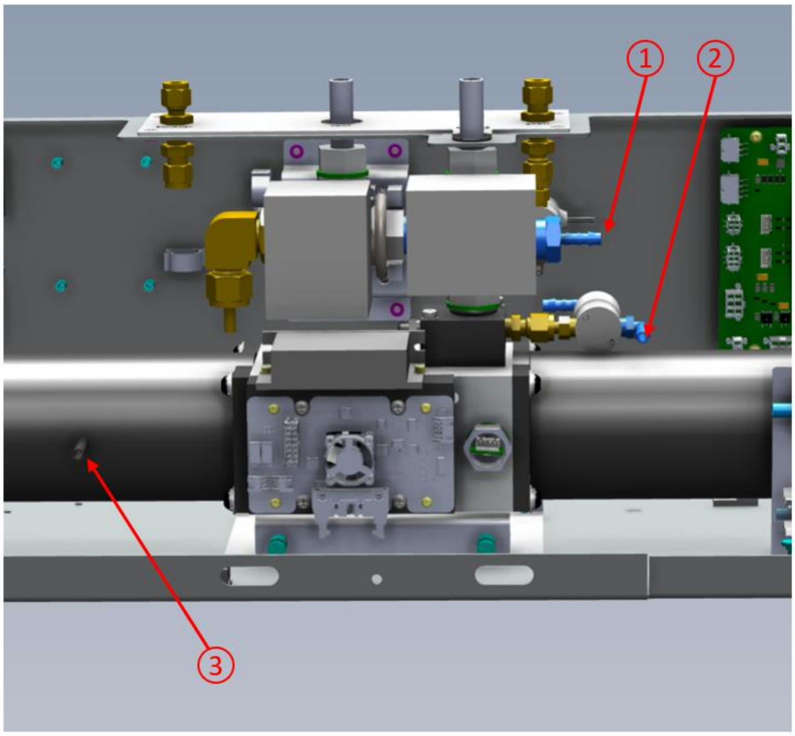


Figure 166 – Location of Tubing to be Removed

4. Remove the sample inlet tube in the direction of the blue arrow

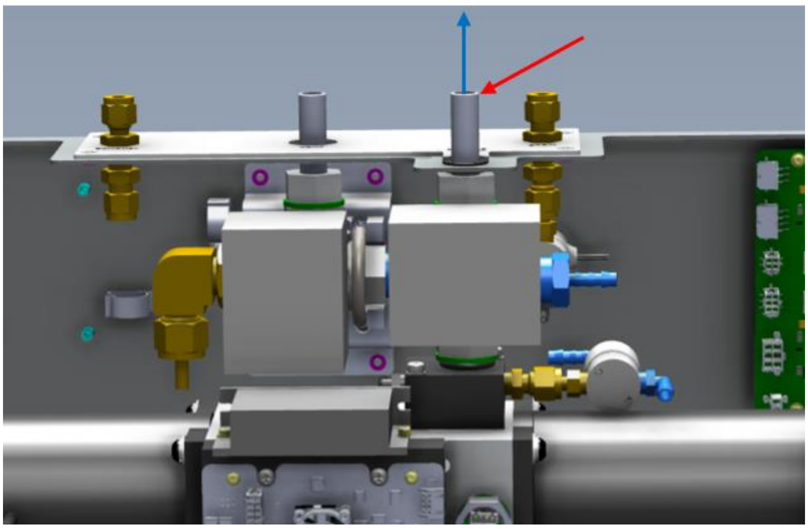


Figure 167 – Sample Inlet Tube Location

5. Remove the filter holder bracket by unscrewing the 2 captive screws and then place to one side.

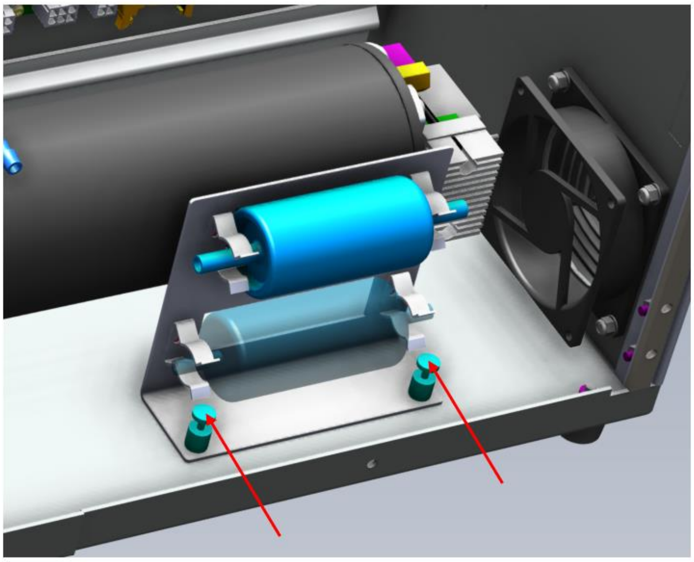


Figure 168 – Filter Holder Captive Screw Location

6. Disconnect the following connectors:
    a. Light source ribbon cable
    b. Heater connecter from J17 & J18 on the Control PCA
    c. J22 on the Control PCA
    d. J14 & J6 on the Microprocessor PCA
7. Using a long M4 screwdriver, loosen the captive screws on the cell bracket two at the front and two at the back, all accessed from the front. As seen in the below image.

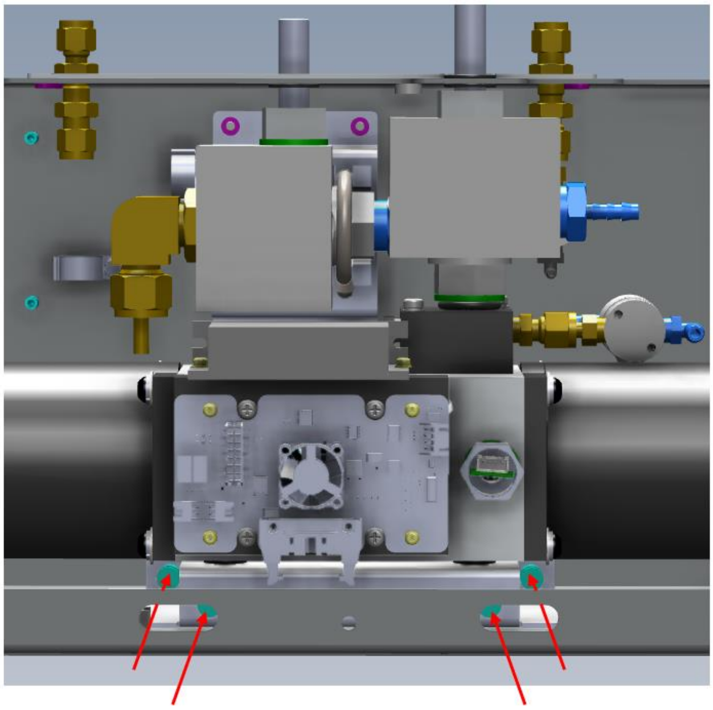


Figure 169 – Indication of Access For Cell Bracket Captive Screws

8. Slide the cell forward and to the left (be careful not to damage the light source ribbon cable) Just enough to be able to access the two screws that secure the sample manifold to the cell.
9. Remove the two M4 screws from the top of the sample manifold.

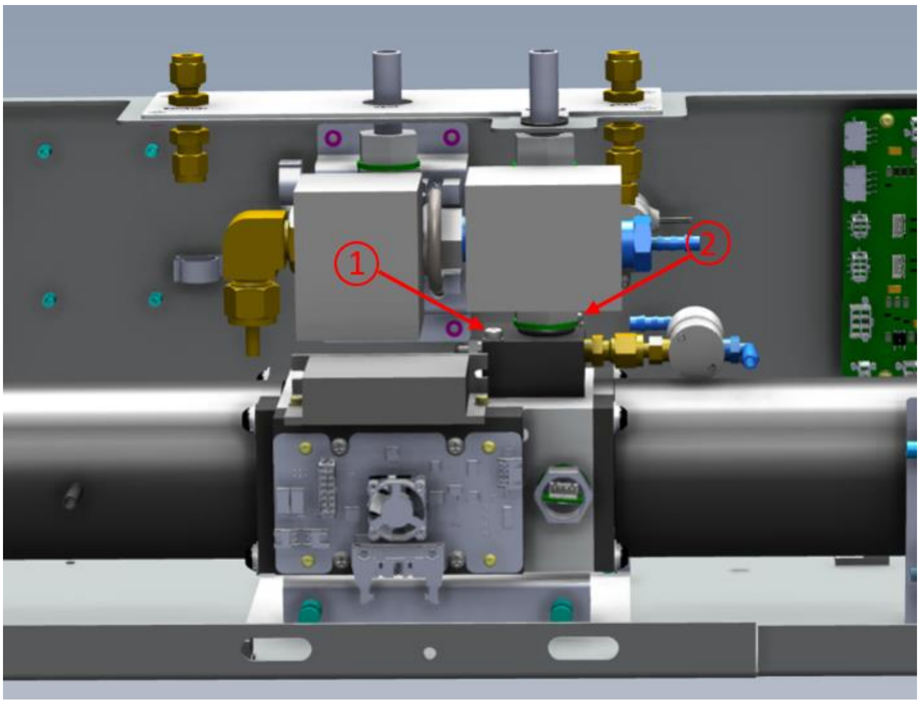


Figure 170 – Location of Sample Manifold Screws

10. The manifold is now only held in place by an O-ring. Lift the sample manifold off the cell and place it on top of the chassis directly above (ball valve side up) with some bubble wrap under it for protection. The tubing still connected should just be long enough to allow for this.

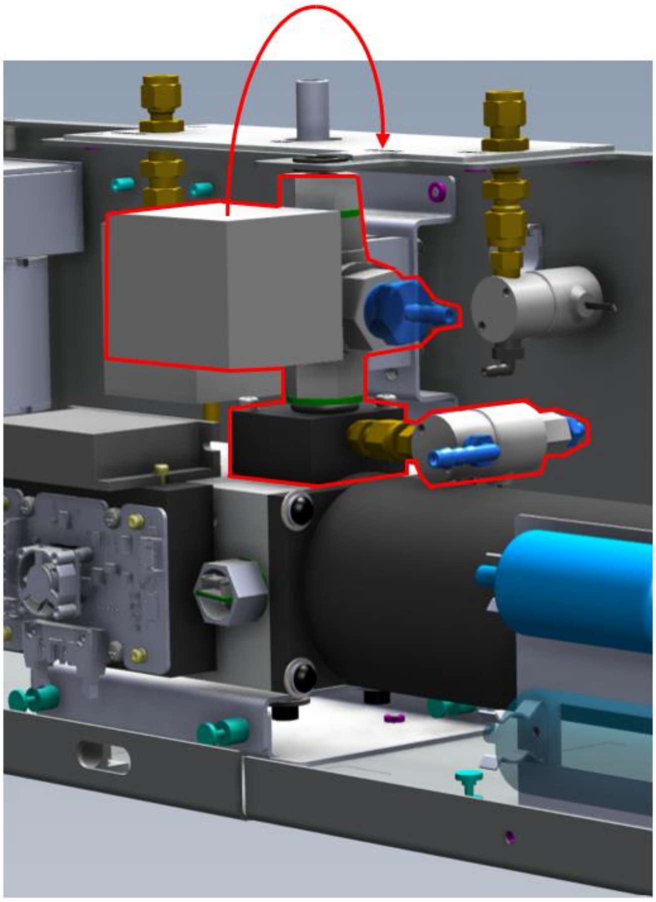


Figure 171 – Placement of Sample Manifold Assembly

11. Remove the optical cell from the chassis.

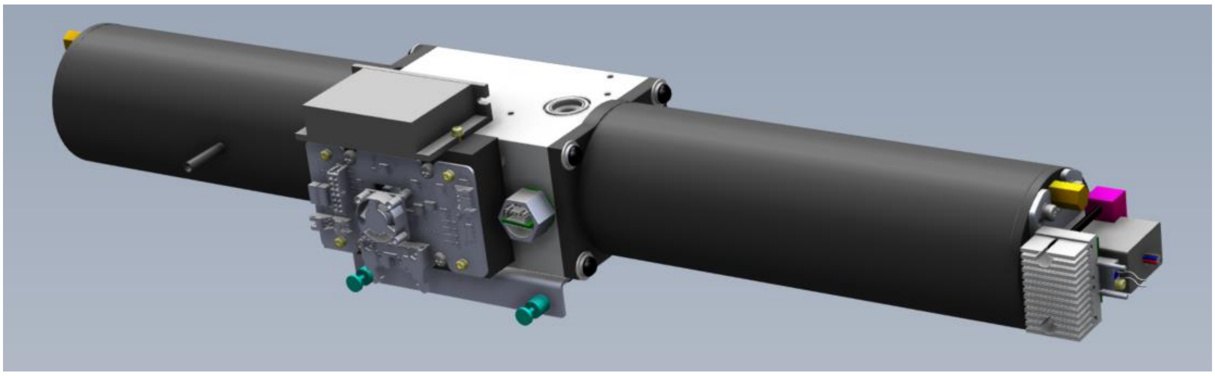


Figure 172 – Image of Extracted Optical Cell

6.4.9.2 Optical Cell Cleaning

1. Remove two brass nuts from each end of the optical cell.

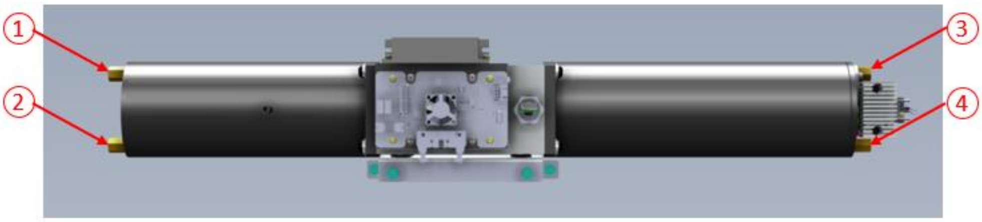


Figure 173 – Location of Brass Nuts

2. Move the PMT end plate away from the tube casing breaking the O-ring seal.

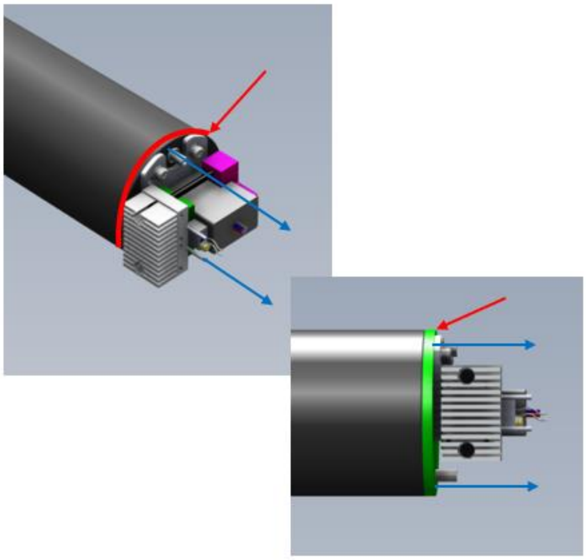


Figure 174 – PMT Endplate Removal

CAUTION

The PMT is sensitive to light, caution should be taken to reduce the amount of light exposed to the PMT such as a darkened room or damage will occur to the PMT.

Note: The endplate is held in by a friction fit of the surrounding O-ring. You may need to use plastic shims to aid in breaking the seal. Once the seal of the O-ring is broken stop removing the endplate.

3. In a darkened area or using a dark cloth to cover the PMT and endplate. Proceed to remove the endplate and cover the PMT window with electrical tape. Place to one side.

Note: It is a good idea to fold over one end of the electrical tape to create a pull tab for easy removal on reassembly.

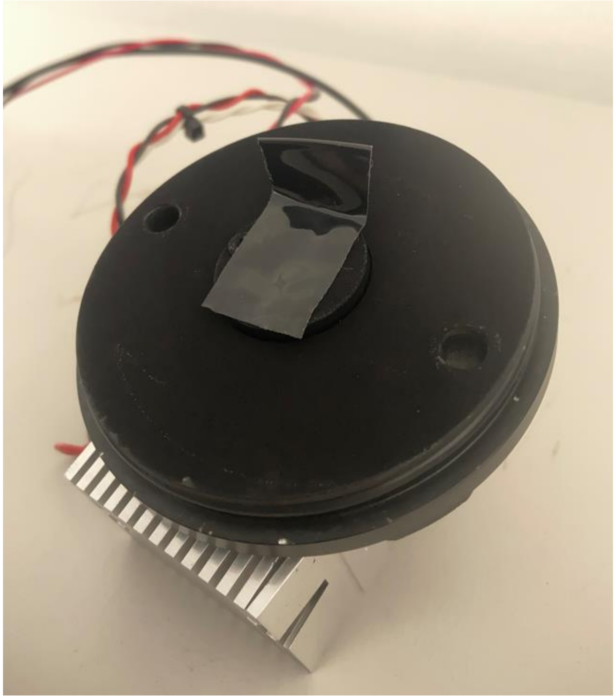


Figure 175 – Covered PMT Window

4. Remove the tube casing PMT end. Support the top of the optical cell with one hand and with the other hand firmly grip the twist the tube casing while slightly pulling away from the block until you break the seal of the O-ring. Then stop and go to the next step.

Note: The tube casing is held in by a friction fit of the surrounding O-ring. You may need to use plastic shims to aid in breaking the seal. Once the seal of the O-ring is broken stop removing the tube casing and proceed with the next step.

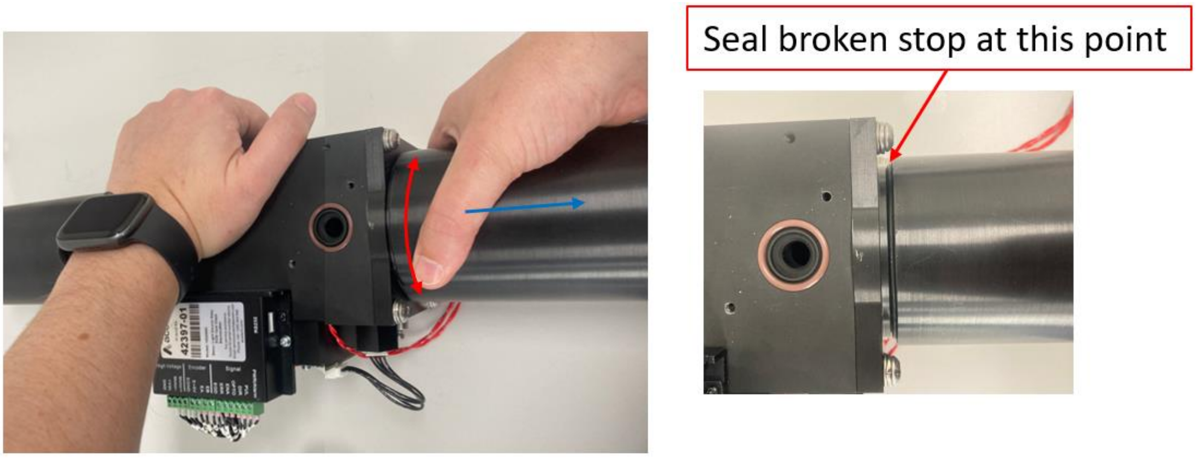


Figure 176 – Tube Casing Removal – PMT End

5. Change your grip and have one hand support the front of the tube casing and your other hand support the back. Pull the tube casing away from the block taking care not to scratch the surface of the baffles or the inside of the tube casing. Place to one side.

6. Remover the light trap endplate. Place to one side.

Note: The endplate is held in by a friction fit of the surrounding O-ring. You may need to use plastic shims to aid in breaking the seal. Once the seal of the O-ring is broken stop removing the endplate.

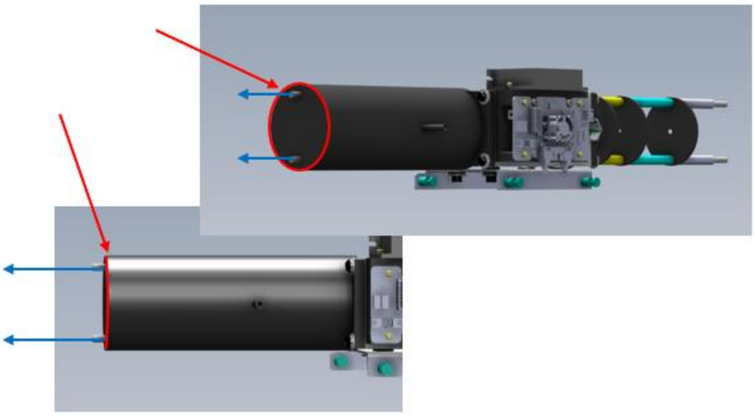


Figure 177 – Light Trap Endplate Removal

7. Remove the tube casing light trap end. Support the top of the optical cell with one hand and with the other hand firmly grip the twist the tube casing while slightly pulling away from the block until you break the seal of the O-ring. Then stop and go to the next step.

Note: The tube casing is held in by a friction fit of the surrounding O-ring. You may need to use plastic shims to aid in breaking the seal. Once the seal of the O-ring is broken stop removing the tube casing and proceed with the next step.

8. Change your grip and have one hand support the front of the tube casing and your other hand support the back. Pull the tube casing away from the block taking care not to scratch the surface of the baffles or the inside of the tube casing. Place to one side.

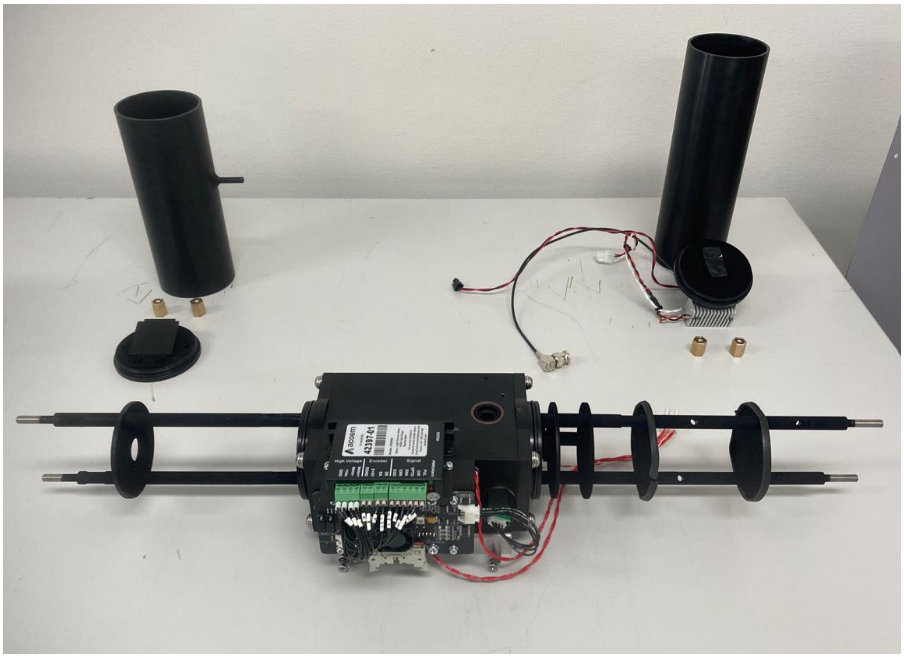


Figure 178 – Endplates and Tube Casings Removed

9. Remove the temp, pressure and RH sensor and the light source.
   a. Remove the cable connecting the TPRH sensor to the light source (red arrow) and unscrew the sensor from the block (green arrow) turning the sensor housing counter clockwise.

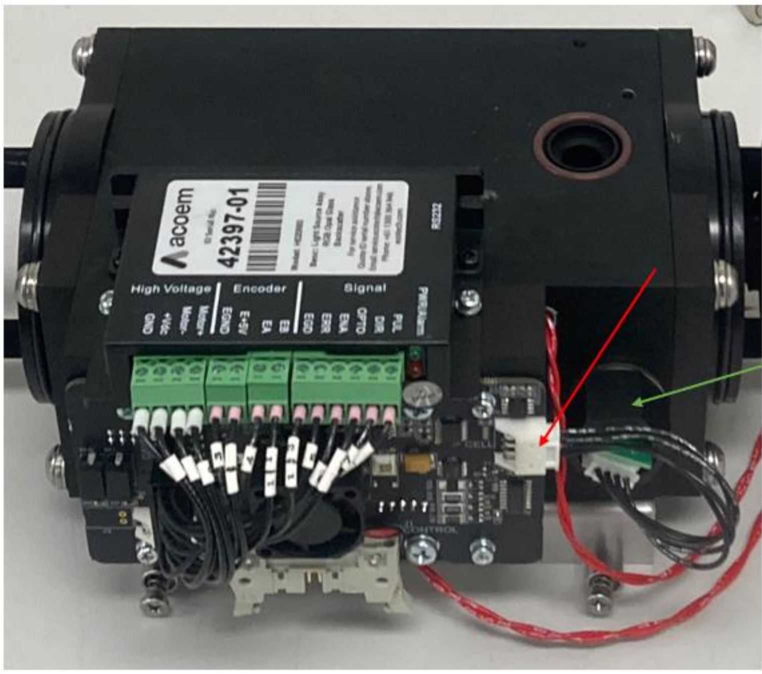


Figure 179 – Location of TPRH Sensor and Cable

   b. Remove the four screws securing the light source and replace them with the guiding pins then gently pull out the light source.

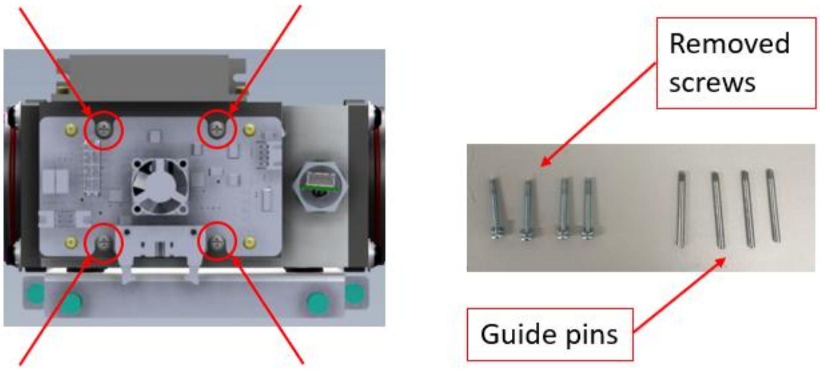


Figure 180 – Location of Light Source Screws

10. The optical cell is now fully exposed. Inspect the quality of the paint on the spacers and baffles, with clean dry oil free air remove any built up dust, inspect all painted surfaces of the removed assemblies, clean the light trap mirror, check the condition of the O-rings and replace if necessary, check the thermal paste on the heaters and replace if necessary.

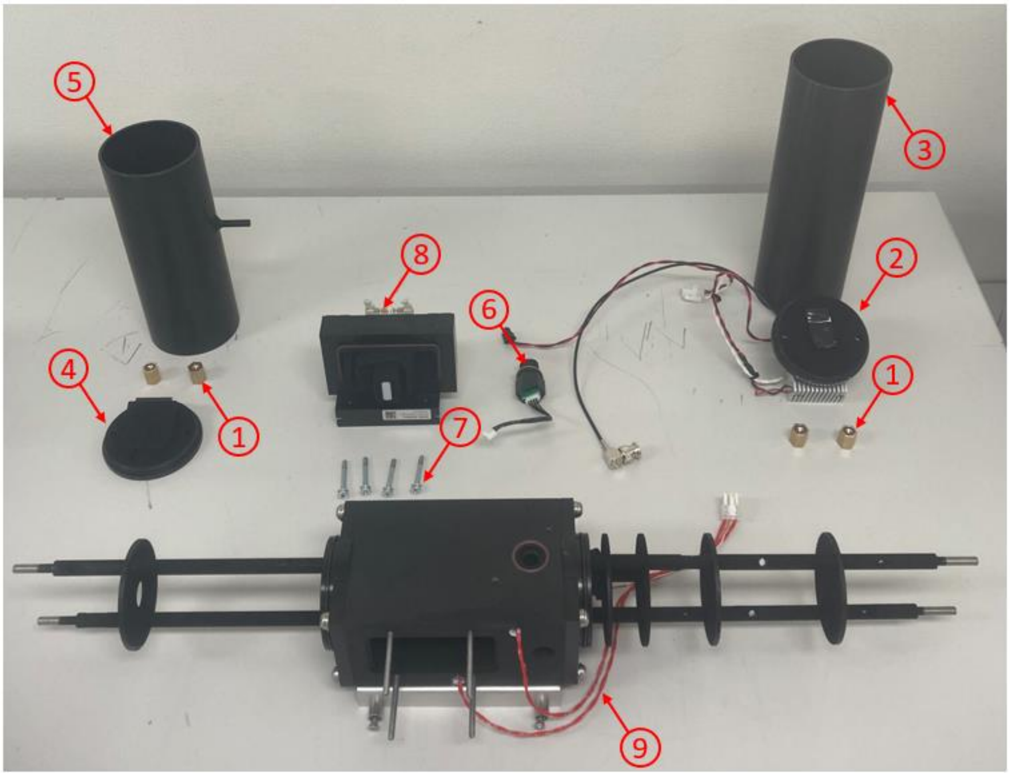


Figure 181 – Disassembled Optical Cell Parts Identification

1. Brass nuts
2. PMT end cap assembly
3. Tube casing (PMT end)
4. Light trap end cap assembly
5. Tube casing (light trap end)
6. Temp, pressure, RH sensor
7. Light source screws
8. Light source assembly
9. Exposed optical cell

6.4.9.3 PMT Assembly Cleaning

The following procedure focus specifically on the PMT assembly and assumes you have already completed the procedures in section 6.4.9.1 and 6.4.9.2, removing and cleaning the optical cell.

1. The PMT is light sensitive, continue to cover the PMT between inspection to ensure that the PMT's exposure to light is minimised.
2. Carefully inspect the quartz window trying to minimise the exposure to light. If you can see finger prints or it appears to be dirty, clean with a precision electronic cleaning solvent which leaves no residue, low toxicity and has a CO_2 propellant (CRC CO Contact Cleaner). DO NOT USE Isopropanol (IPA).

3. Spray a small amount of the electronic cleaning solvent on a lint free tissue or cotton bud, then quickly apply it to the quartz window.

Note: Take care when applying the solvent not to rub off the black paint.

4. Using a fresh section of the lint free tissue or a fresh cotton bud to remove any excess solvent and clean the window.
5. Re-inspect the window trying to minimise the exposure to light.

6.4.9.4 Reference Shutter Cleaning

The following procedure focus specifically on the reference shutter assembly and assumes you have already completed the procedures in section 6.4.9.1 and 6.4.9.2, removing and cleaning the optical cell.

1. Clean the reference shutter glass with a lint free tissue or cotton bud and warm clean water, then leave to dry. If the baffles are dirty, clean them in a similar manner or by using compressed air.

6.4.9.5 Light Source Cleaning

The following procedure focus specifically on the light source assembly and assumes you have already completed the procedures in section 6.4.9.1 and 6.4.9.2, removing and cleaning the optical cell.

1. Clean the opal glass window of the light source with a lint free tissue or cotton bud and warm clean water, then leave to dry.
2. Gently inspect the operation of the backscatter shutter and the condition of the painted surface. Remove any dust build up using a microfiber cloth or by using compressed air.

6.4.9.6 Light Trap Mirror

The following procedure focus specifically on the light trap mirror assembly and assumes you have already completed the procedures in section 6.4.9.1 and 6.4.9.2, removing and cleaning the optical cell.

1. Be very careful not to touch the mirror surface.
2. Inspect the light trap mirror surface using a very bright torch (e.g., LED type), and viewing it from various angles. Look for signs of white streaks or dust in the centre of the glass.
3. If the glass surface does need cleaning, use a precision electronic cleaning solvent which leaves no residue, low toxicity and has a CO_2 propellant (CRC CO Contact Cleaner). DO NOT USE Isopropanol (IPA).
4. Spray the electronic cleaning solvent on the surface of the glass, then quickly using a lint free tissue, remove the solvent in one continuous sweep covering the full width of the glass. Then re-inspect the mirror with a torch to ensure there is no residue.

Note: Surface dust can be cleaned by lightly blowing with clean dry oil free air or using a horse hair camera lens cleaner.

6.4.9.7 Sample Path Cleaning

The following procedure focus specifically on the sample manifold assembly and assumes you have already completed the procedures in section 6.4.9.1 removing the optical cell.

1. Clean the sample manifold by using compressed air blown through the inlet or cotton bud with a long stem and warm clean water, then leave to dry.

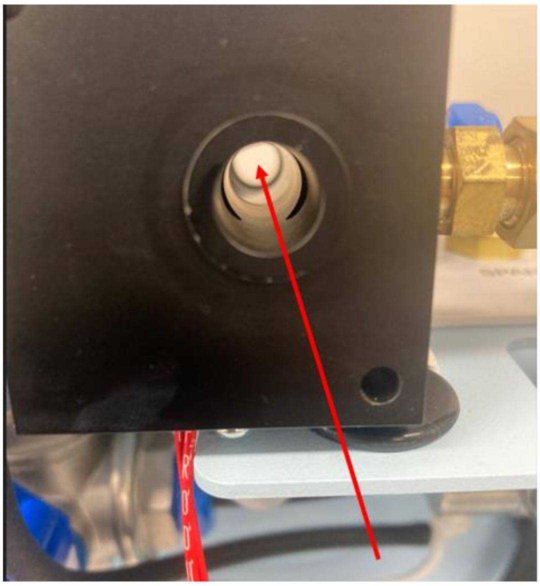


Figure 182 – Sample Manifold Cleaning

6.4.9.8 Optical Cell Reassembly

The following procedure focus specifically on the optical cell reassembly and assumes you have already completed the procedures in section 6.4.9.1 and 6.4.9.2, removing and cleaning the optical cell.

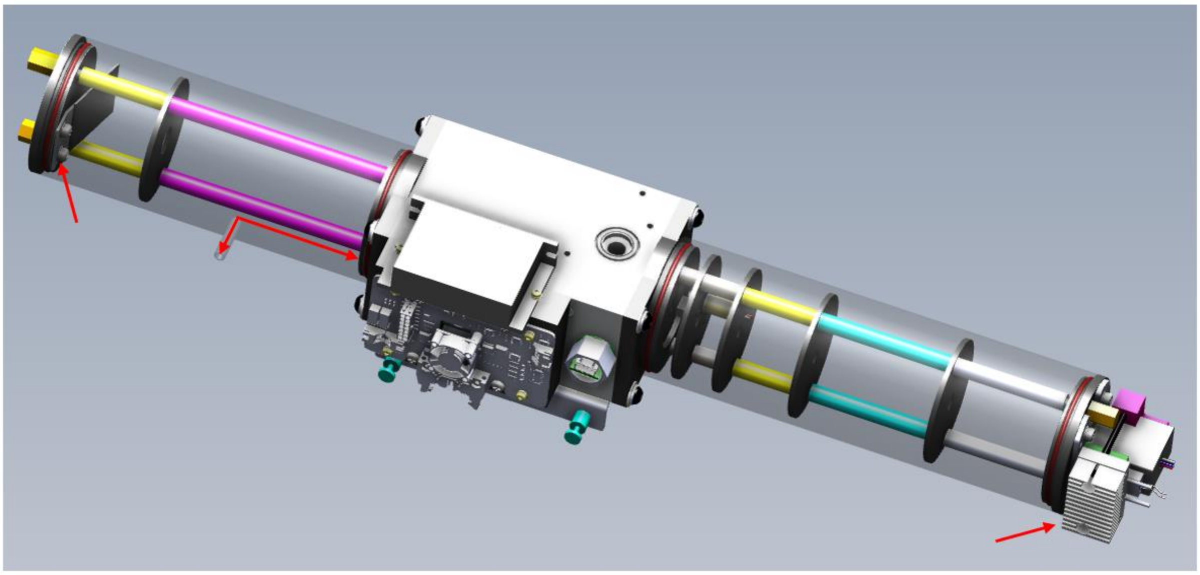


Figure 183 – Optical Cell Transparent Tube Casing

1. With all parts of the chamber cleaned and dry, it is now time to reassemble the optical chamber back to its original condition.
2. Using the guiding pins gently slide the light source back into place on the block. Remove the guide pins and replace the M4 screws.
3. Replace the temp, pressure and RH sensor back into the block turning the sensor housing clockwise until hand tight. Then reconnect the cable to the light source PCA.
4. Replace the tube casing (light trap end) by sliding it back over the baffles taking care not to damage the paint. Refer to Figure 183 for the orientation of the casing (sample exhaust side closest to the block). Supporting the casing with both hands will give the best result. Once the casing reaches the block end you will need to change your hand placement, one hand used to support the block while twisting the casing with the other hand while also pushing towards the block. Care should be taken not to pinch the O-ring or your leak check will fail.
5. Place the light trap end plate over the threaded stubs and into the tube casing. Refer to Figure 183 for the direction of the light trap. Wiggle and press into place. Care should be taken not to pinch the O-ring or your leak check will fail.
6. Screw on the two brass nuts along with the small O-rings and tighten hand tight. The seal of the threaded stub is done by the small O-ring against the face of the end plate.
7. Replace the tube casing (PMT end) by sliding it back over the baffles taking care not to damage the paint. Supporting the casing with both hands will give the best result. Once the casing reaches the block end you will need to change your hand placement, one hand used to support the block while twisting the casing with the other hand while also pushing towards the block. Care should be taken not to pinch the O-ring or your leak check will fail.
8. Place the PMT end plate over the threaded stubs and into the tube casing. Refer to Figure 183 for the direction of the PMT assembly (heat sink of the PMT facing the light source side). Wiggle and press into place. Care should be taken not to pinch the O-ring or your leak check will fail.
9. Screw on the two brass nuts along with the small O-rings and tighten hand tight. The seal of the threaded stub is done by the small O-ring against the face of the end plate.

6.4.9.9 Optical Cell Installation

1. Replace the optical cell into the chassis, position the optical cell slightly forward and to the left (be careful not to damage the light source ribbon cable).
2. Replace the sample manifold ensure the O-ring is still in place on the optical cell and secure with the two M4 screws.

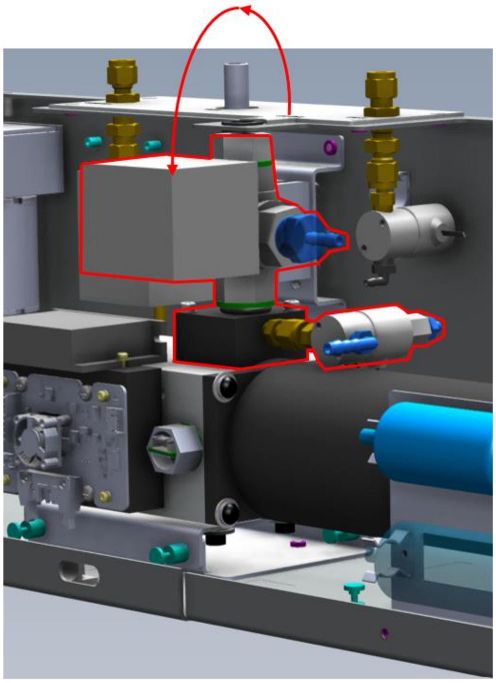


Figure 184 – Replacing the Sample Manifold Assembly

3. Slide the optical cell and sample manifold back and to the right until the two brackets align. Using a long M4 screwdriver, tighten the captive screws on the cell bracket two at the front and two at the back, all accessed from the front. As seen in the below image.
4. Reconnect the following connectors:
    a. Light source ribbon cable
    b. Heater connecter from J17 & J18 on the Control PCA
    c. J22 on the Control PCA
    d. J14 & J6 on the Microprocessor PCA
5. Replace the filter holder bracket by tightening the 2 captive screws.

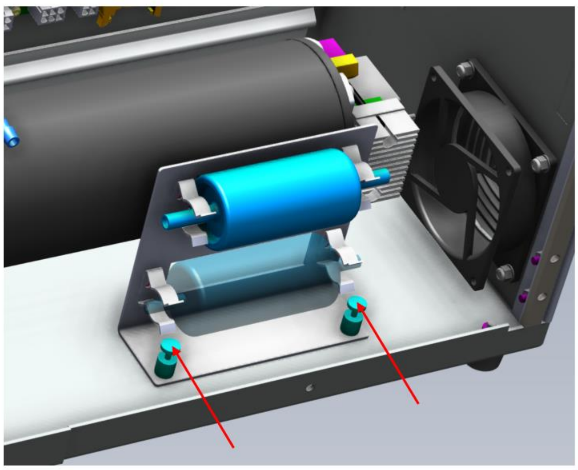


Figure 185 – Replacing the Filter Holder Bracket

6. Re-insert the sample inlet tube.

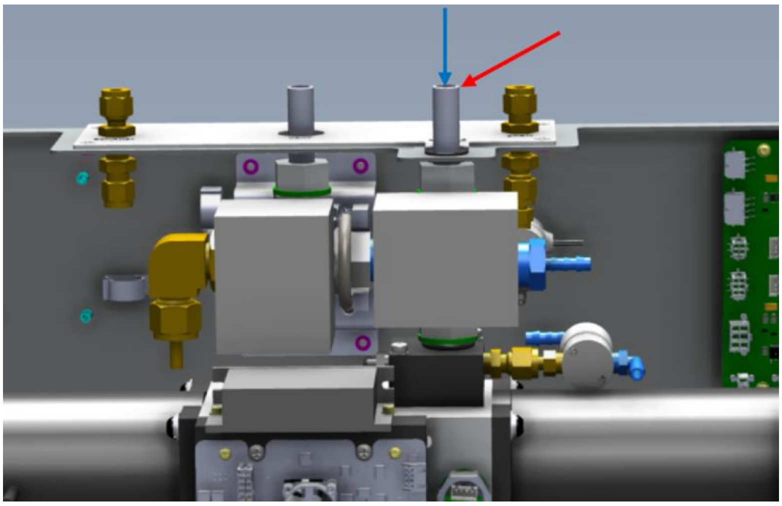


Figure 186 – Replacing Sample Inlet Tube

7. Connect the tubing to the following points on the optical cell and the sample manifold.

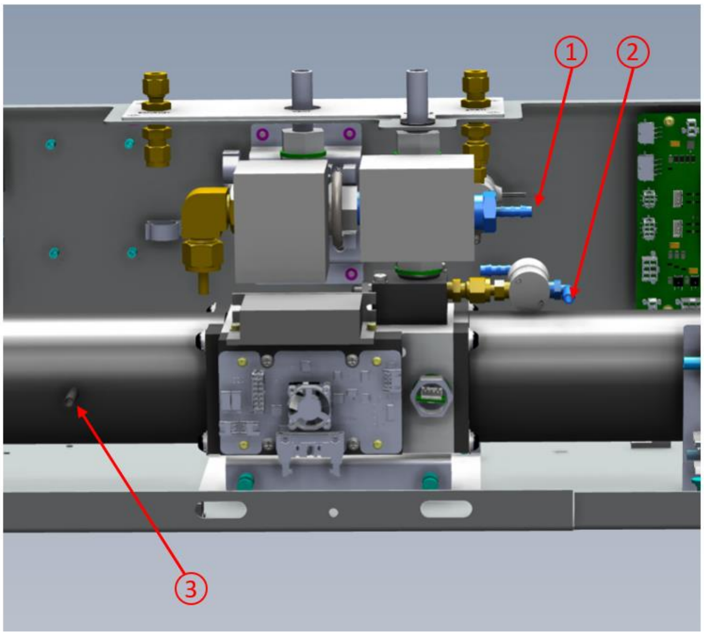


Figure 187 – Reconnecting Tubing

8. Conduct a leak check (refer to Section 6.4.10). When the leak check has passed replace the lid and close the door.
9. Conduct a full calibration, then normal operation can begin.

6.4.10 Leak Check

There are two methods to perform a leak check. method “A” will use an automated process controlled by the microprocessor. Method “B” is a faster method that should be used for troubleshooting should method "A" fail. Method a should be used first.

6.4.10.1 Method “A” – Automated Leak Check.

This leak test is automated and will record the results to the configuration files.

1. Some preparation is required, before commencing the automated leak check, disconnect anything connected to the sample inlet, the vent and the span gas ports.
2. From the home page touch the config button to navigate to the Config page.
3. On the config page user setting panel, enable service menus (green radio button).
4. Navigate back to the home page, then navigate to the Cal page then the Sensors child page.
5. On the leak check panel touch Start, this will create a popup dialog box seeking conformation that you want to start the leak check. Selecting Cancel will close the dialog box and cancel the operation accept will stop the normal instrument measurement.

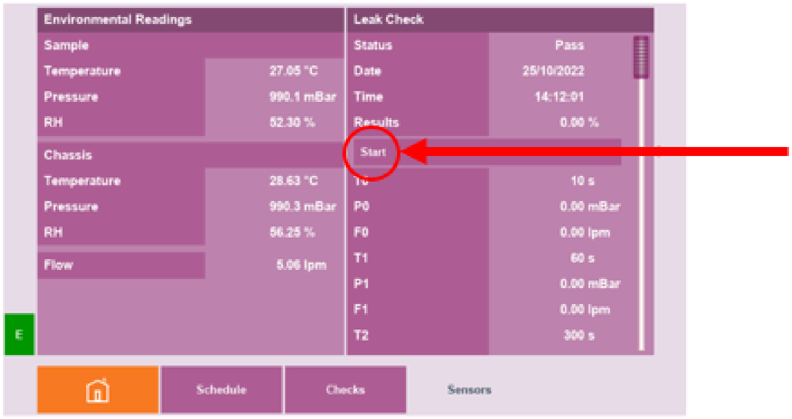


Figure 188 – Location of Leak Check Start Button

6. Using the two black 1/2" rubber caps, block the sample inlet port and vent port. Also make sure the Span gas port is disconnected.

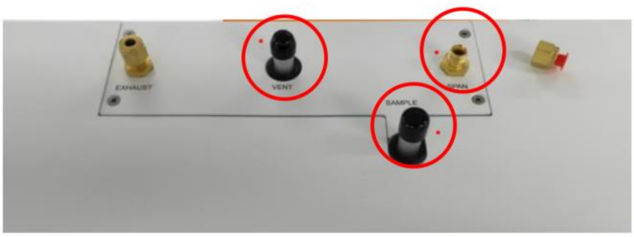


Figure 189 – Image of Port Preparation

7. Another pop up dialog box will ask to confirm that the above action has been done. Select Accept.
8. Some valves will change and the pump will start evacuating the cell for 1 minute.
9. If sufficient pressure reduction is not achieved a pop up dialog box will appear saying slow leak and asking if you want to try again. Select Accept to try again or Cancel to Abort the Check.
10. If sufficient pressure reduction is achieved, the Leak Check will continue for 5 minutes measuring the change in pressure. If the test passes you will be prompted to Accept and complete the test.

11. When the test is complete Disconnect the two black 1/2" rubber caps and re connect the sample inlet and Span Gas line.
12. The results of the Leak Check will be displayed at the top of the menu when the test is complete. These results are stored in the calibration file.
13. Navigate to the Config page (Home page –> Config page) and on the user setting panel, disable service menus (red radio button).
14. If Method A fails, you can use method B to assist with trouble shooting to resolve the leak.
15. Always use Method A as the final Method before moving on to the next step.

6.4.10.2 Method "B" – Manual Leak Check

This procedure assumes you have followed method "A" and it has failed.

Stage 1

1. Switch off power to the instrument.
2. Make sure nothing is connected to the span port or vent Port.
3. Apply a 1/2" black rubber cap to the sample Inlet port on the top of the instrument.
4. Switch on the instrument and observe the sample flow and pressure on the home page.
    a. The sample pump will slowly increase to maximum speed.
    b. The Sample pressure will decrease to less than 150 mBar
    c. The Sample Flow will decrease to less than 0.1 slpm.

Figure 190 – Example of Pressure and Flow

5. If all these conditions are met with in 5 minutes, then the leak check has passed Stage 1.

Stage 2

1. Navigate to Cal page –> Calibration Settings panel, open vent ball valve, to release the cell pressure.
    a. The sample pressure should return to ambient.
    b. The sample flow should remain at less than 0.1 slpm.

2. If all these conditions are met with in 1 minute, then the leak check has passed Stage 2.
3. Remove the 1/2" black rubber cap from the sample Inlet port.
4. Navigate to Cal page –> Calibration Settings panel, close the vent ball valve, to return to normal operation.
    a. The sample Pressure should be at Ambient readings.
    b. The sample Flow should return to target set point.
5. Leak Test Method "B" in now complete.

6.4.11 Zero Noise Test

Calculating the zero noise is the best way to confirm the operational performance of the Aurora NE Series. The following procedure explains how to do this:

1. Operate the Instrument at room temperature for at least 30 minutes before starting this test.
2. Set the Aurora NE Series into zero calibration mode for a period of 2 hours. This can be done by using either of the following three methods:
    a. In the calibration menu, set the minimum calibration time to 120 minutes, and the maximum calibration time to 121 minutes, then set it to do a zero check. Or
    b. On the 25pin external IO connector, connect pin 7 (DO ZERO) to pin 20 (Digital GND) to put it in zero mode. Or
    c. Connect an external Disposable Filter Unit (DFU) to the sample inlet during normal sampling mode. Or
3. Navigate to the In the Datalog Parameters panel (Home page –> Config page –> Datalog Parameters panel), set the Period to 1 minute.
4. Allow the Aurora NE Series to continue running on zero air for a period of 120 minutes (2 hours), uninterrupted.
5. When the 2 hours are complete, download the 2 hours of zero data to a PC.
6. Using MS Excel, import the data into a new spread sheet.
7. For the scattering data use the STDEV() command in Excel to calculated the Standard Deviation of the zero data over the 2 hour period for each of the scattering parameters.
8. This calculated standard deviation is the zero noise value for that particular instrument.
9. If the zero noise is less than 0.15 Mm^{-1}, then the instrument is considered to be in good working order. If the instrument zero noise is above 0.15 Mm^{-1}, then this could be due to a number of factors:

- Pneumatic leak in the cell or plumbing,
- Light leak near the PMT,
- Dirty measurement cell or optical chamber,
- Low intensity light source,
- Dirty light trap mirror,
- Noisy PMT

6.4.12 Light Source Test and Adjustment

The performance of the light source and backscatter shutter can be verified without having to remove the light source from the optical cell. The following procedures are simple checks which can be done. Ultimately the, calculating the zero noise is the best way to confirm the overall operational performance of the Aurora NE Series.

6.4.12.1 NE-100 Light Source Test

Note: The Aurora NE-100 light source has three wavelengths to be tested. Only one wavelength can be tested at a time.

1. Confirm that the wavelengths are 635 nm, 525 nm & 450 nm in that order.
2. Confirm that the 90 degree Position is set to 0 or 1.
3. Confirm that four polar polynomials (Constant, x, x2 x3) are set to 0 if shown.
4. Any changes made in the light source panel will require confirmation. Press Accept when it appears.
5. Now select Home page –> Cal page –> Calibration Settings panel, and set the Source to Zero.
6. The instrument will now sample Zero air so that the LEDs can be checked for optimum performance. Allow 5 minutes to stabilise.
7. From the home page touch the config button to navigate to the Config page.
8. On the config page user setting panel, enable service menus (green radio button).
9. Touch home to return to the Home page –> Cal page –> Measurement Settings panel.
10. Scroll down until you find the three wavelength settings.

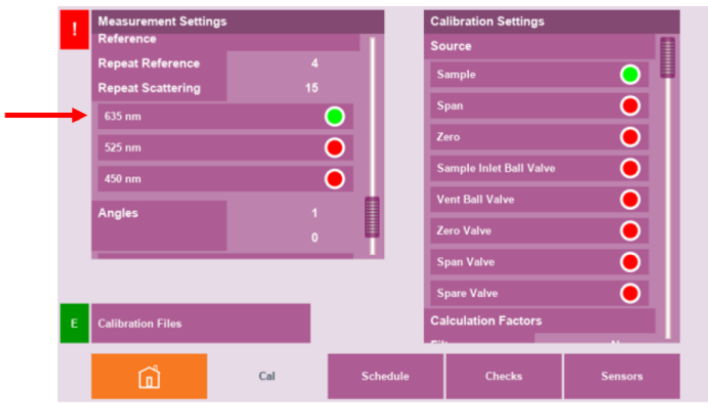


Figure 191 – Example of Wavelength Selection

11. Select the 635 nm wavelength radio button and select Accept.
12. Return to the Home screen, Select Readings –> 635 nm and take note of the Measure Count. (Not Measure Count Raw). Make sure Zero Measure has been operating for 5 minutes. The measure count target for the 635 nm wavelength is in the range of 2000 – 10000.

Note: If the Wide Bandwidth PMT option (E010200) is installed, then this range should be between 10000 – 12000.

13. Select Readings, 635 nm and observe the Shutter Count. This reading should be > 1,000,000 if the Wide Bandwidth PMT option is installed. Otherwise it is not important as long as it is greater than the Measure Count by a factor of at least 10.

Note: The Shutter Counts will only update every 30 - 60 seconds.

14. If the 635 nm Measure Counts are correct, move on to 525 nm wavelength test.
15. Navigate to Cal page –> Measurement Settings panel and select the 525 nm radio button and Accept.
16. Select Readings –> 525 nm and observe the Measure Count. The measure count target for the 525 nm wavelength is in the range of 10000 – 15000.
17. Select Readings –> Wavelength 525nm and observe the Shutter Count. This reading should be in the range 1,000,000 – 5,000,000.

Note: The Shutter Counts will only update every 30 - 60 seconds.

18. If the 525 nm Measure Counts are correct, move on to 450 nm.
19. Navigate to Cal page –> Measurement Settings panel and select the 450 nm radio button and Accept.
20. Select Readings –> Wavelength 450 nm and observe the Measure Count. The measure count target for the 450 nm wavelength is in the range of 10000 – 20000.
21. Select Readings –> Wavelength 450 nm and observe the Shutter Count. This reading should be in the range 1,000,000 – 5,000,000.

Note: The Shutter Counts will only update every 30 - 60 seconds.

6.4.12.2 NE-300 and NE-400 Light Source Test

1. Confirm that the wavelengths are 635 nm, 525 nm & 450 nm in that order.
2. Confirm that the 90 degree Position is set to 0 or 1.
3. Confirm that four polar polynomials (Constant, x, x2 x3) are set to 0 if shown.
4. Any changes made in the light source panel will require confirmation. Press Accept when it appears.
5. Now select Home page –> Cal page –> Calibration Settings panel, and set the Source to Zero.
6. The instrument will now sample Zero air so that the LEDs can be checked for optimum performance. Allow 5 minutes to stabilise.
7. Navigate to Home page –> Readings –> 635 nm and take note of the 90° Measure Count. (Not Measure Count Raw). Make sure Zero Measure has been operating for 5 minutes. The measure count target for the 635 nm wavelength @ 90° is in the range of 10000 – 12000.
8. Observe the Shutter Count. This reading should be in the range of 1,000,000 – 5,000,000.

Note: The Shutter Counts will only update every 30 - 60 seconds.

9. Check that the 0° Measure Count is greater than the 90° Measure Count by more than 2000.
10. Navigate to Home page –> Readings –> 525 nm and take note of the 90° Measure Count. (Not Measure Count Raw). The measure count target for the 525 nm wavelength @ 90° is in the range of 10000 – 15000.

11. Observe the Shutter Count. This reading should be in the range of 1,000,000 – 5,000,000.

Note: The Shutter Counts will only update every 30 - 60 seconds.

12. Check that the 0° Measure Count is greater than the 90° Measure Count by more than 2000.
13. Navigate to Home page –> Readings –> 450 nm and take note of the 90° Measure Count. (Not Measure Count Raw). The measure count target for the 450 nm wavelength @ 90° is in the range of 10000 – 20000.
14. Observe the Shutter Count. This reading should be in the range of 1,000,000 – 5,000,000.

Note: The Shutter Counts will only update every 30 - 60 seconds.

15. Check that the 0° Measure Count is greater than the 90° Measure Count by more than 2000.

6.4.13 Full Calibration and Precision Checks.

Refer to Section 5.0

6.4.14 Clock Battery Replacement

Over the life of the instrument at some point the backup battery may need to be replaced. The frequency will depend on how the instrument is used. Instrument stored for long periods without power will reduce the overall life of the backup battery. The following procedure covers how to check, extract and replace the battery.

6.4.14.1 Clock Battery Check

To check the clock battery you will require a multimeter.

1. Using a multimeter set to Volts DC, measure the clock battery voltage on the microprocessor PCA by placing the negative probe on TP1 (GND) and the positive probe on the top of the battery.

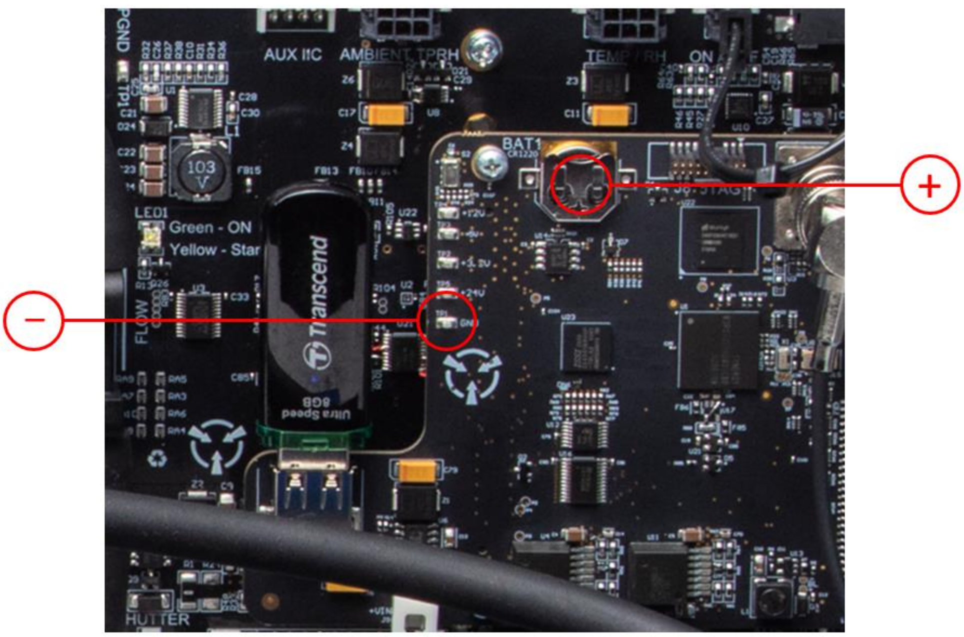


Figure 192 – Polarity of Clock Battery Test Points

2. The battery voltage measured between TP1 and the top of the holder should be between 2.0 V and 3.6 V.

6.4.14.2 Clock Battery Removal

1. Before removing the battery, some preparation is required. Using some clear packing tape, cut a square size section of the tape and place it to one side sticky side up.
2. Be mindful of ESD (electro static discharge) when working near the microprocess PCA, ensure you are wearing appropriate clothing and you are sufficiently grounded, such as the use of a anti-static strap.
3. Switch off power to the instrument.
4. Locate the BAT1 battery holder located on the microprocessor PCA. With the aid of a tooth pick (something nonconductive) carefully extract the cell battery from the holder.

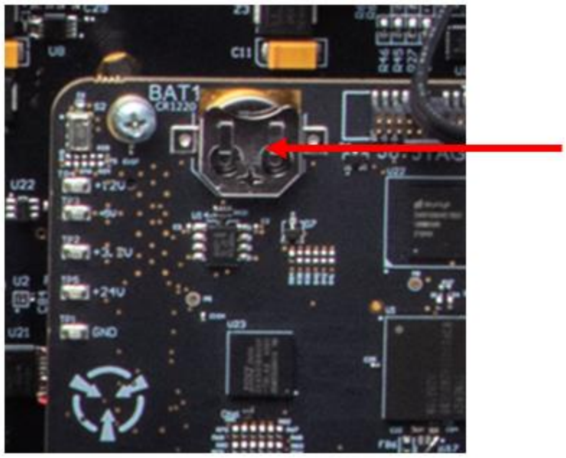


Figure 193 – Location of Battery Holder

5. Place the extracted battery onto the left half of the packing tape (sticky side).
6. Fold the tape over and seal the battery within. This will prevent the battery shorting or making contact with other batteries.
7. Dispose of the battery in the correct manner (refer to your local standards for Lithium battery disposal).

6.4.14.3 Clock Battery Replacement

This procedure assumes you have followed the battery backup removal procedure.

1. Ensure power to the instrument is still off.
2. Install the CR1220 3 V Lithium battery (PN: B040023) into to the BAT1 battery holder positive ("+") side up (facing towards the user), taking care not to bend the battery holder.
3. Check the battery voltage (refer to Section 6.4.14.1).
4. Switch on power to the instrument.
5. Select Config. In the User Settings Panel, set the Current Date by touching the date.

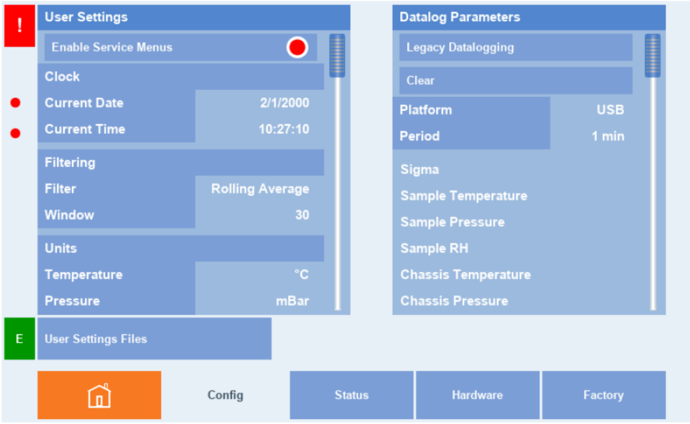


Figure 194 – Example of Current Date and Time

6. Repeat the same for the Current Time.
7. Touch the Home button to return to the home page and check that the time and date are correct and that the time is incrementing.
8. Switch off power to the instrument for 1 minute.
9. Switch on power to the instrument and check that the time and date are still correct.

6.5 Firmware Upgrading

Firmware upgrades provide access to new features as they are developed by Acoem. Upgrading the firmware is a simple process.

Before upgrading the firmware, make sure you have backup copies of the Configuration Files, Calibration Files, Hardware Files, and Lightsource Files.

6.5.1 Enter Bootloader mode

The bootloader is an application that runs every time the instrument is powered up. It checks the integrity of the firmware before launching the familiar Aurora application. The bootloader also provides the option of upgrading new firmware.

Navigate to the Config page then the Factory child page. In the Identification panel, touch the Run Bootloader button.

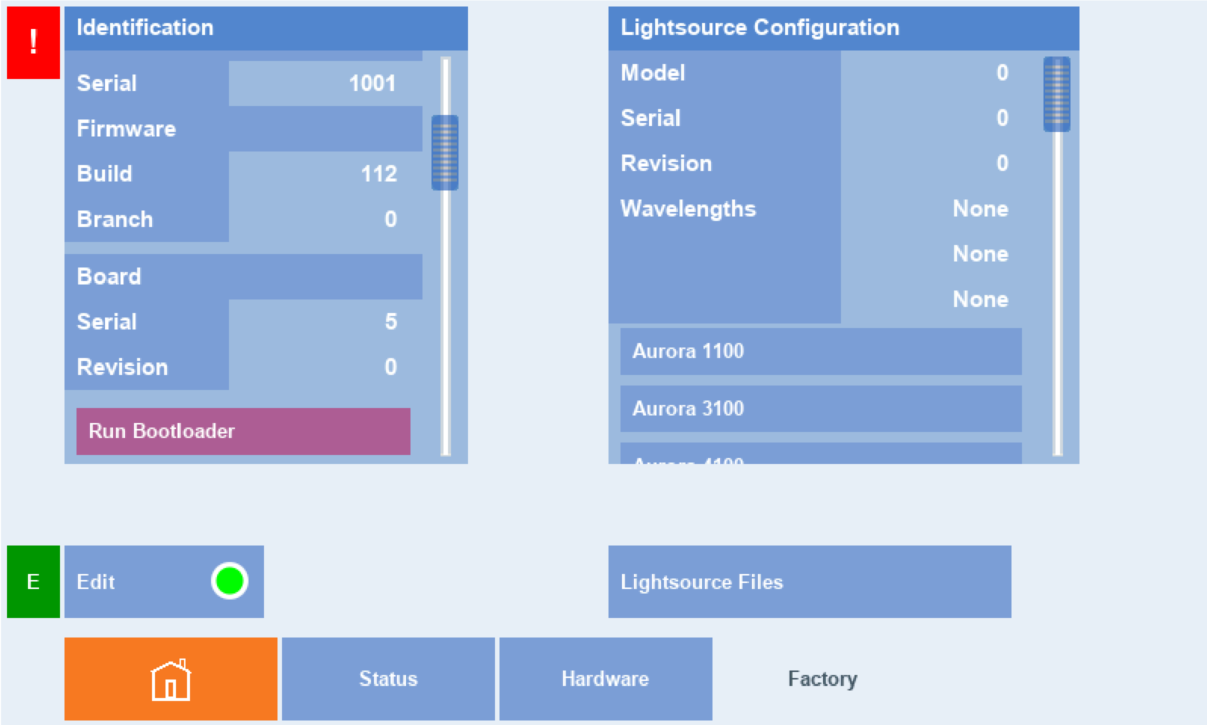


Figure 195 – Run Bootloader Button

The instrument will immediately return to the bootloader.

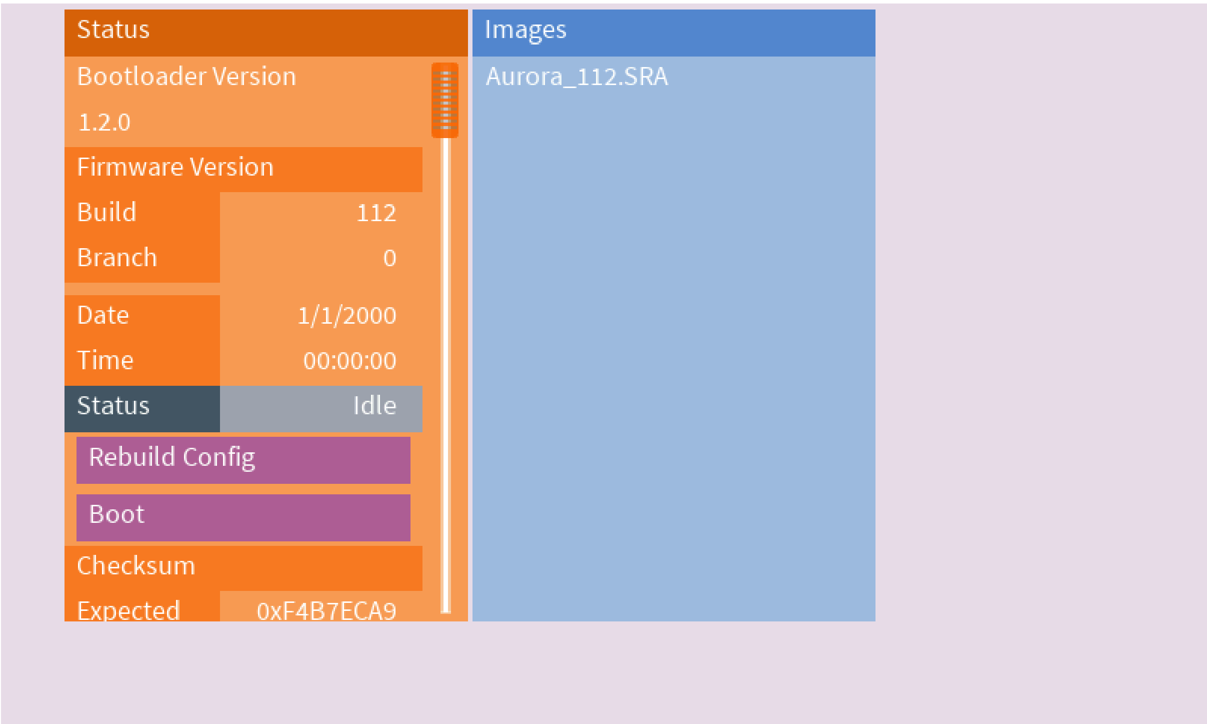


Figure 196 – Bootloader Page

6.5.2 Prepare the USB Memory Stick

Remove the USB memory stick and copy the new `Aurora_XXX.SRA` firmware file (where XXX is the build number) to the directory /FIRMWARE. Reinsert the USB memory stick and wait until the images panel list shows the contents of the USB memory stick.

6.5.3 Load the firmware

Touch and hold the desired firmware file. From the pop-up menu, select Load. When the flashing process is complete, the instrument will reboot and run the new firmware.

6.5.4 Troubleshooting

If something goes wrong the instrument will reboot in bootloader mode. The most common cause is an incompatible configuration; try pressing the Rebuild Config button and then the Boot button. After the application starts you can reload your configuration file to restore the original state.

If this does not resolve the issue, try loading a different firmware file, or contact Acoem technical support.

7. Troubleshooting

Before troubleshooting any specific issues, Acoem Australasia recommends ensuring the instrument has successfully completed its warm-up routine.

Table 7 – Common Errors and Troubleshooting

Error Message/Problem	Cause	Solution
Flow fault	Pump failed	Replace the internal or external pump.
Noisy/unstable readings		
Lightsource Fail		
Cell temperature failure		
Reference Shutter Fail		
Instrument resetting		
PMT Failure		
No display		
Sample pressure too high or low		
Backscatter High		
Calibration results		
Zero Offset		
Negative response		
Leak Check Fail		

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8. Optional Extras

This section contains information on optional kits and installed options.

Mass Flow Control 20 LPM	Refer to Section 8.1.
External Pump 240 VAC	Refer to Section 8.2
External Pump 110 VAC	Refer to Section 8.3
Aerosol Conditioning System (ACS1000)	Refer to Section 8.4
Wall Mount Bracket	Refer to Section 8.5
Roof Flange	Refer to Section 8.6
Rain Cap Inlet and Screen	Refer to Section 8.7
1/2" Inlet Tubing extensions	Refer to Section 8.8
PM_{10} Inlet (3 LPM)	Refer to Section 8.9
$PM_{2.5}$ Inlet (3 LPM)	Refer to Section 8.10
External Pump Controller Kit	Refer to Section 8.11
Service Kit	Refer to Section 8.12
Calibration Kit	Refer to Section 8.13
Black Silicone Carbon Tubing	Refer to Section 8.14
Aerosol Dryer	Refer to Section 8.15
Low Due Point Air Source	Refer to Section 8.16
Wide Bandwidth PMT	Refer to Section 8.17
Ambient Temp & RH Sensor	Refer to Section 8.18

8.1 Mass Flow Control 20 LPM (PN: E010110)

The MFC option allows the Aurora NE to precisely control flow up to 20 LPM with the fitment of a 20L Mass Flow Controller, MFC control PCA and cabling.

8.2 External Pump 240 VAC (PN: P030004)

The optional 240 VAC pump assembly is designed to be used in conjunction with the External Pump Controller and MFC option to provide stable vacuum and flow for correct operation of the MFC up to 20 LPM.

8.3 External Pump 110 VAC (PN: P030005)

The optional 110 VAC pump assembly is designed to be used in conjunction with the External Pump Controller and MFC option to provide stable vacuum and flow for correct operation of the MFC up to 20 LPM.

8.4 Aerosol Conditioning System (PN: E010010)

TBA

8.5 Wall Mount Bracket (PN: E010112)

The wall mounting bracket option is used to fix the Aurora NE to a flat vertical surface with a purpose made bracket that allows the Aurora NE to be quickly installed or uninstalled.

8.6 Roof Flange (PN: E010130)

The roof flange kit allows weather proof sealing of a roof penetration and allows a 1/2" tube to be passed through for sampling from the external ambient environment.

8.7 Rain Cap Inlet and Screen (PN: E010131)

A purpose made assembly that installs to a 1/2" tube sample line and is used to prevent excessive moisture and insects from entering the 1/2" tube sample line.

8.8 1/2" Inlet Tubing Extension (PN: H020321, H020322, H020323 , H020324)

This option has various lengths of 1/2" aluminium tube that can be used to connect to the sample inlet of the Aurora NE. Generally they are used to collect sample from an external source via a roof flange penetration.

8.9 PM_{10} Inlet (3 LPM) (PN: H020449)

Inlet assemblies designed to selectively remove particles larger than the nominal size from the sample at the designed flow rate of 3 LPM. The assemblies are designed to adapt to 1/2" sample tube or 1/2" sample tube extensions

8.10 $PM_{2.5}$ Inlet (3 LPM) (PN: H020450)

Inlet assemblies designed to selectively remove particles larger than the nominal size from the sample at the designed flow rate of 3 LPM. The assemblies are designed to adapt to 1/2" sample tube or 1/2" sample tube extensions

8.11 External Pump Controller Kit (PN: E010115)

The external pump controller kit is designed to connect the Pump Control output of the Aurora NE to control a suitable 110/240VAC pump (P030004/P030005) so the pump only runs when required and removes the need for the user to manually turn the pump on and off.

8.12 Service Kit (PN: E010120)

TBA

8.13 Calibration Kit (PN: H020331)

TBA

8.14 Black Silicone Carbon Tubing (PN: T010031)

Carbon-impregnated silicone tubing designed to provide a leak-free connection between 1/2" aluminium tubing sections such as the sample inlet tube and 1/2" aluminium tubing extensions. The black silicone carbon tubing is anti-static and provides a suitable path for aerosols.

8.15 Aerosol Dryer (PN: E010009)

A standalone membrane dryer that passes the sample air inside a Nafion membrane while ultra low dew point air (E040035) is continuously passed on the outside of the dryer. This removes water vapour providing a dry sample stream.

8.16 Low Due Point Air Source (PN: E040035 or E040036)

The Low Dew Point Air Source is an Air Generator supplied with a multi-stage membrane drying panel to provide a very low dew point up to -40 deg C. The Low Dew Point Air Source is ideal for use as a continuous air source for the Aerosol Dryer (E010009) or the ACS1000 (E010010) when fitted with Dryer Module.

8.17 Wide Bandwidth PMT (PN: E010200)

TBA

8.18 Ambient Temp & RH Sensor (PN: E010111)

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9. Parts List and Schematics

9.1 Maintenance Kit

This maintenance kit is required when performing routine maintenance on the instrument. Depending on the environment that the instrument is operating, this maintenance may need to be carried out more often than yearly.

Table 8 – Aurora NE Series Annual Maintenance Kit - (PN: E010120)

Part Description	Part Number	Quantity
O-RING 1 15/16 X 3/32, BS135,	25000420-2	1
BATTERY, 3V, COIN CELL TYPE	B040023	1
SAFETISS, LINT FREE WIPES	C060002	-
FILTER, DFU, 0.01 MICRON,	F010034	1
FILTER, 0.1 MICRON, 95%, DFU,	F010038	1
WASHER DOWTY, SS, VITON,	H080208	1
O-RING, 1/2ID X 1/16W,	O010008	4
O-RING, 1/4ID X 1/16W,	O010015	4
O-RING 0.799ID X 0.103W, BS117	O010029	1
O-RING BS148, DURO 70, NITRILE	ORI-1007	4
V-RING, V10A, VITON,	ZRU-22006361	1

9.2 Consumables

Parts shown as consumables below will require replacement over the course of the instrument's lifespan.

Table 9 – Aurora NE Series Consumables

Consumable	Part Number
Zero Filter 99.99% (0.01 Micron)	F010034
Pump Filter 95% (0.1 Micron)	F010038
Exhaust Filter (23 Micron)	F010005
3/8" OD, 1/4" ID Black Norprene Tubing (Unit Per ft)	T010030
1/4" OD, 1/8" ID Black Norprene Tubing (Unit Per ft)	T010021
CLAMP, HOSE, 0.38" OD	028-080270

9.3 Instrument Parts List

List of Aurora NE Series components and part numbers for reference.

Note: Before referring to the spare part number confirm the part number and its location in attached drawings.

Table 10 – Spare Parts List (Main Components)

Part Description	Part Number
NE-100 Microcontroller PCA Spare Part	C010060-10
NE-300 Microcontroller PCA Spare Part	C010060-30
NE-400 Microcontroller PCA Spare Part	C010060-40
Control PCA Spare Part	C010061-50
LCD PCA Spare Part	C010062-50
Touch Screen LCD Display Spare Part	D010003-50
Light Source Assembly (NE-400)	H020660-02
Light Source Assembly (NE-300)	H020660
Light Source Assembly (NE-100)	H020660-01
Cell Assembly	H020670
PMT Assembly with Cooler (NE-300 & NE-400)	H020650
PMT Assembly (NE-100)	H020651
Door Assembly Spare Part	H020090
Internal Sample Pump	H020635
Sample Manifold Block	H020626
Span and Zero Valve Assembly	H020630
Sample Ball Valve Assembly (Crimp Ends Only No Connector)	H020625
Vent Ball Valve Assembly	H020620
3V Backup Battery (Coin Cell Type)	B040023
24V Power Supply 160W	P010023

Table 11 – Spare Parts List (Filters)

Part Description	Part Number
Exhaust Filter (23 Micron)	F010005
Zero Filter 99.99% (0.01 Micron)	F010034
Pump Filter 95% (0.1 Micron)	F010038

Table 12 – Spare Parts List (Cables/Heaters/Coolers/Sensors)

Part Description	Part Number
Light Source Cable	C020163
Front Door Cable	C020164
Power Switch Cable	C020165
Sample Manifold Block Heater Assembly	C020171
Duel Cell Heater Assembly	C020170
TPRH Sensor Assembly (used on the cell)	H020675
Cooler Thermistor Assembly Spare Part (NE-300 & NE-400)	C020169

Table 13 – Spare Parts List (O-rings/Seals)

Part Description	Part Number
BS135 (1 15/16" x 3/32") O-ring	25000420-2
1/2" Nitrile Dowty Seal Bonded Steel Washer	F030116
1/2" ID x 1/16" W O-ring	O010008
3/4" ID x 1/8" W O-ring	O010049
3" ID x 1/16" W O-ring	O010009
0.426 ID x 0.070 W O-ring	O010011
1/4" ID x 1/16" W O-ring	O010015
BS148 Nitrile Duro 70 O-ring	ORI-1007
BS117 (0.799 ID x 0.103 W) O-ring	O010029
V10A Viton V-ring	ZRU-22006361
3/8" Viton Dowty Seal Bonded Stainless Steel Washer	H080208

Table 14 – Spare Parts List (Fittings/Tubing/Clamps)

Part Description	Part Number
0.38" OD Hose Clamp	028-080270
1/4" ID PTFE Ferrule	F030028
6 mm Nylon Tee Hose Fitting	FIT-09-NYP1406
1/4" ID Swagelok Bulkhead Fitting	28290400-1
1/2" Brass Ferrule to 1/4" Tube Stub Swagelok Port Connector	28440804-1
1/2" Adjustable Brass BSPP to 1/2" Tube Elbow Fitting	F030113
1/2" Blue Nylon BSPT Male Connector to 6 mm Hose Fitting	F030119
1/2" Aluminium BSPP to 1/2" Tube Adapter	H020622
Black Nylon Elbow Fitting	F030003

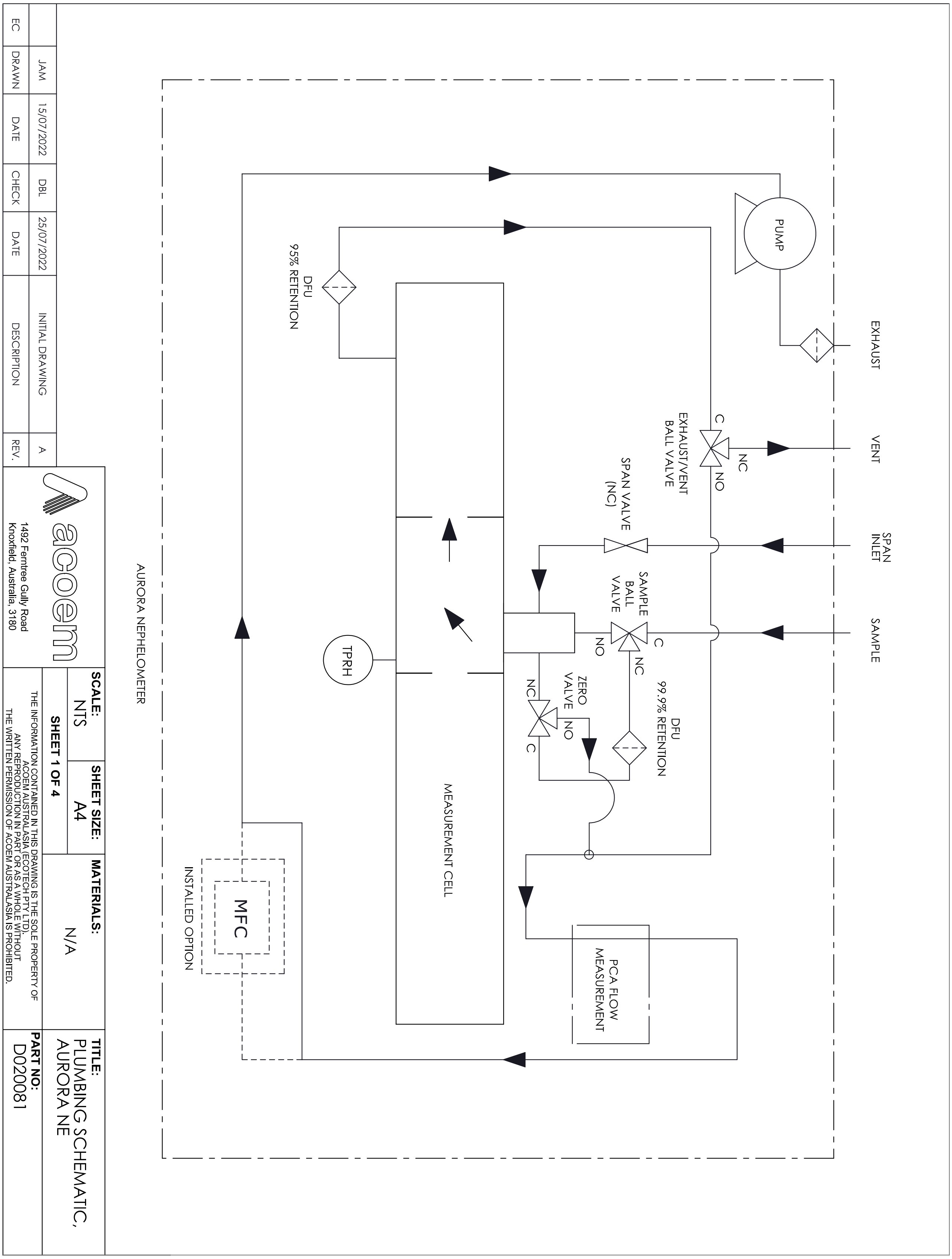
Part Description	Part Number
1/2" Tube for Sample or Vent Inlet	H020627
1/4" Brass Stub to 1/8" NPT Adapter	28590402-1
1/4" Brass Swagelok Nut	28800400-1
1/4" Brass Swagelok Ferrule	28820400-1
1/8" Blue Nylon BSPT Male Elbow to 6 mm Hose Fitting	F030118
1/4" OD, 1/8" ID Black Norprene Tubing (Unit Per ft)	T010021
3/8" OD, 1/4" ID Black Norprene Tubing (Unit Per ft)	T010030

Table 15 – Spare Parts List (Misc.)

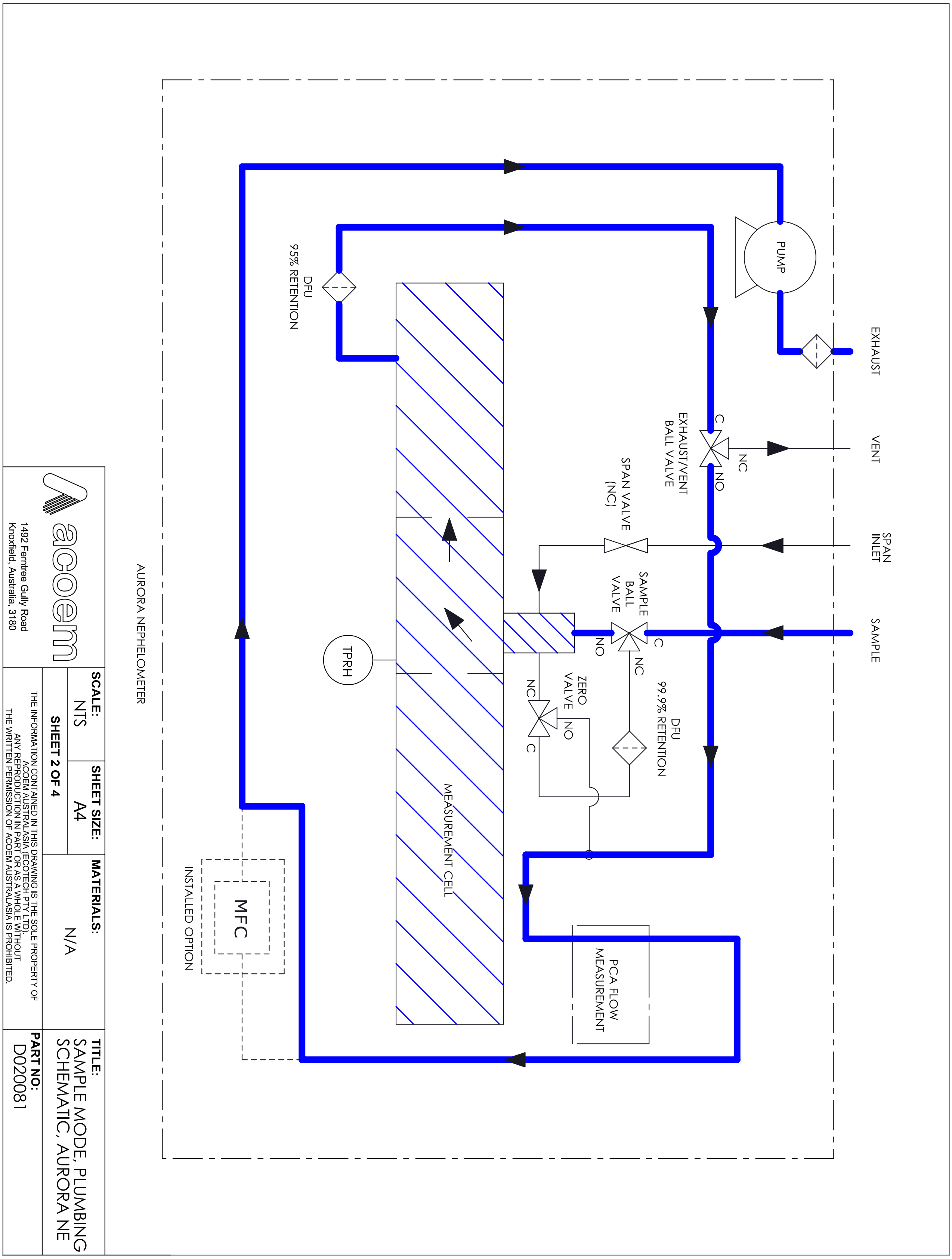
Part Description	Part Number
PMT Bracket	H020016
Chassis Fan 24 V (80 mm x 80 mm) Spare Part	F020002-50
M4 x 9 mm Stainless Steel Thumb Screw	F050113
M3 x 20 mm Brass Plated Female to Female Hex Spacer	F050142
Chassis Foot Bumper (9/16" High)	H010039
NE-100 Chassis Lid Assembly Spare Part	H020082-31
NE-300 Chassis Lid Assembly Spare Part	H020082-30
NE-400 Chassis Lid Assembly Spare Part	H020082-40
Magnetic Push Latch	H020088
Chassis Pneumatic Port Anti Rotation Panel	H020089
LCD Screen Bracket (Hinge End)	H020085
LCD Screen Bracket (Latch End)	H020084
Flat Cable Split Ferrite with Adhesive Base	H030124
Filter Bracket Spare Part	H020091-50
Peripheral Name Plate for Chassis Side Panel	H020092
Cell Mounting Bracket (Chassis side)	H020673
32 GB Micro SD Memory Card	H030136
3/4" OD, 1/2" ID Rubber Grommet for Sample or Vent Inlet	H030190
Thermo Electric Cooler Heatsink (NE-300 & NE-400)	H020696
Thermo Electric Cooler Mounting Bracket (NE-300 & NE-400)	H020697
Thermo Electric Cooler Spacer (NE-300 & NE-400)	H020698
Plate for Thermistor (NE-300 & NE-400)	H020699
PMT Sensor (H10682-67) Spare Part	H020652
Light Source Fan Assembly 12 V (25 mm x 25 mm)	H050031
Quartz Window	859-073900

Part Description	Part Number
M3 x 6 mm Nylon Thumb Screw	F050036
Cell Mounting Bracket (Cell side)	H020672
Shutter & Baffle Assembly	H020700
3/8" OD, 1/4" ID Silicone Grommet	H030079
Light Trap Mirror Assembly	H040010
M6 x 15 mm Brass Nut for Cell End Plates	HAR-M900376
Aurora NE Shipping Carton (800 mm x 300 mm x 340 mm)	B010017
Aurora NE Packaging End Cap	B010036
Aurora NE Packaging Mid Cap	B010037
Aurora NE Plastic Bag	B020001
25g Desiccant Pack	C050012
Green Resources USB Memory Stick	H030137
Internal Sample Pump Rebuild Kit	P031014

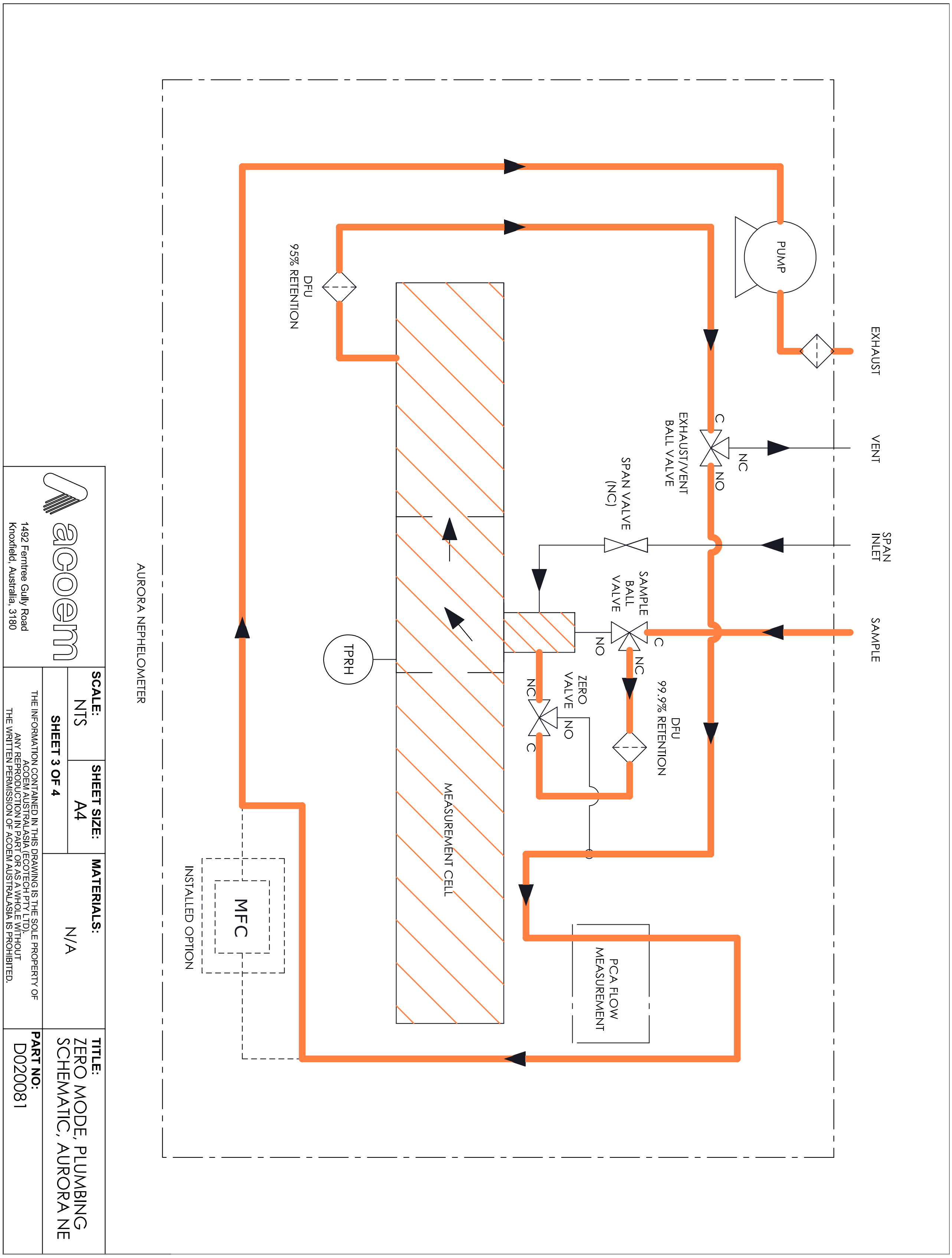
9.4 Plumbing Schematic General - (PN: D020081)



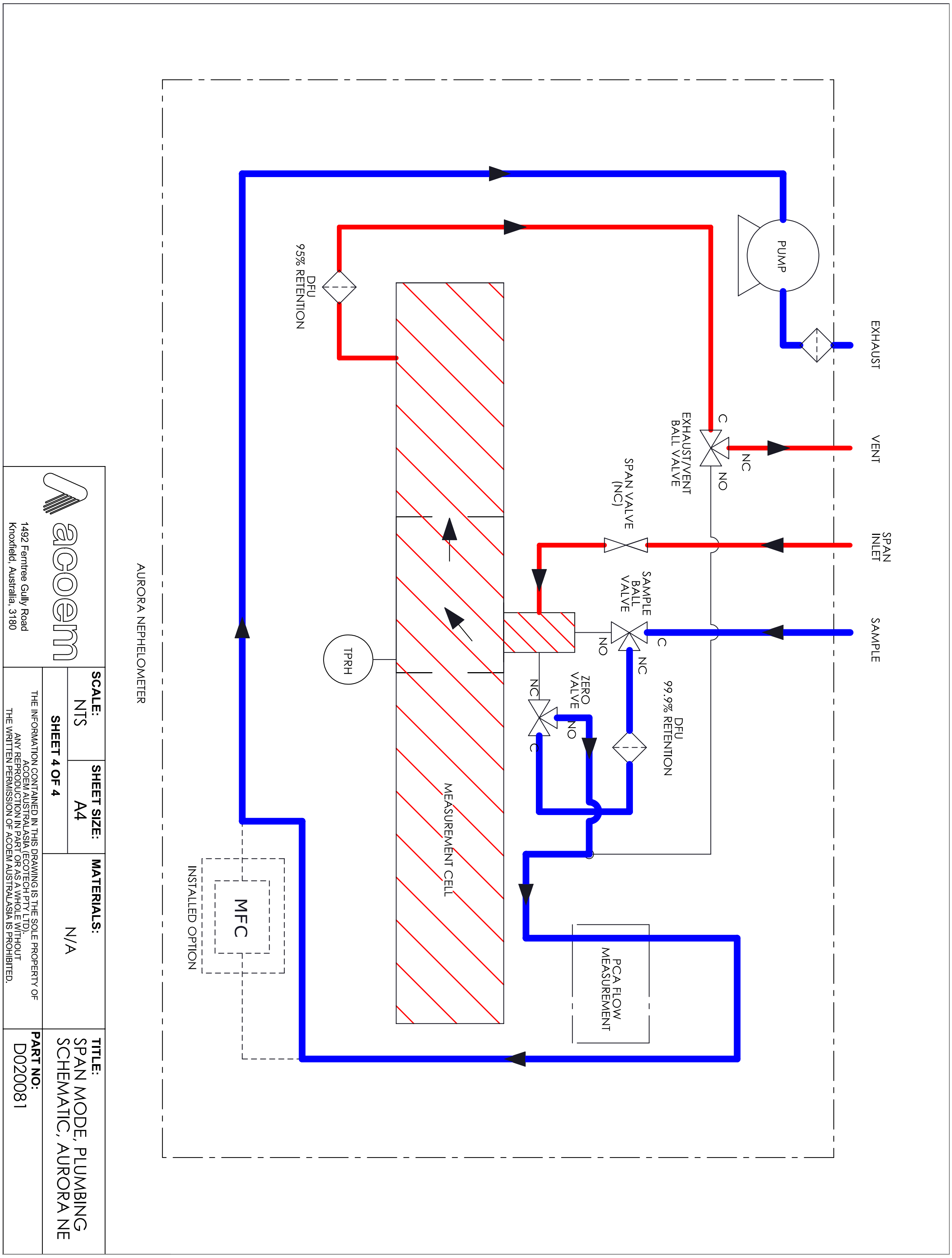
9.5 Plumbing Schematic Sample Path - (PN: D020081)



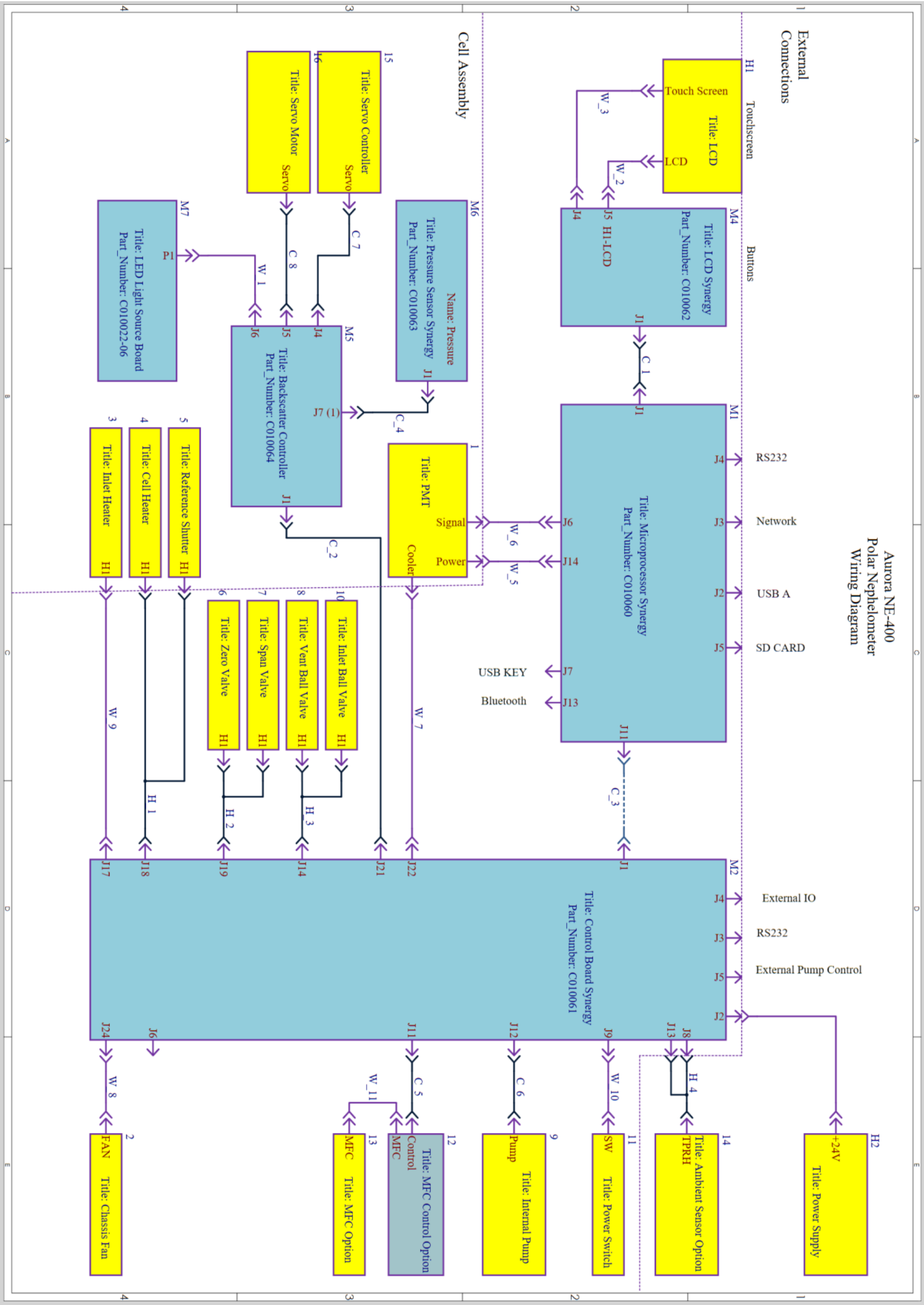
9.6 Plumbing Schematic Zero Path - (PN: D020081)



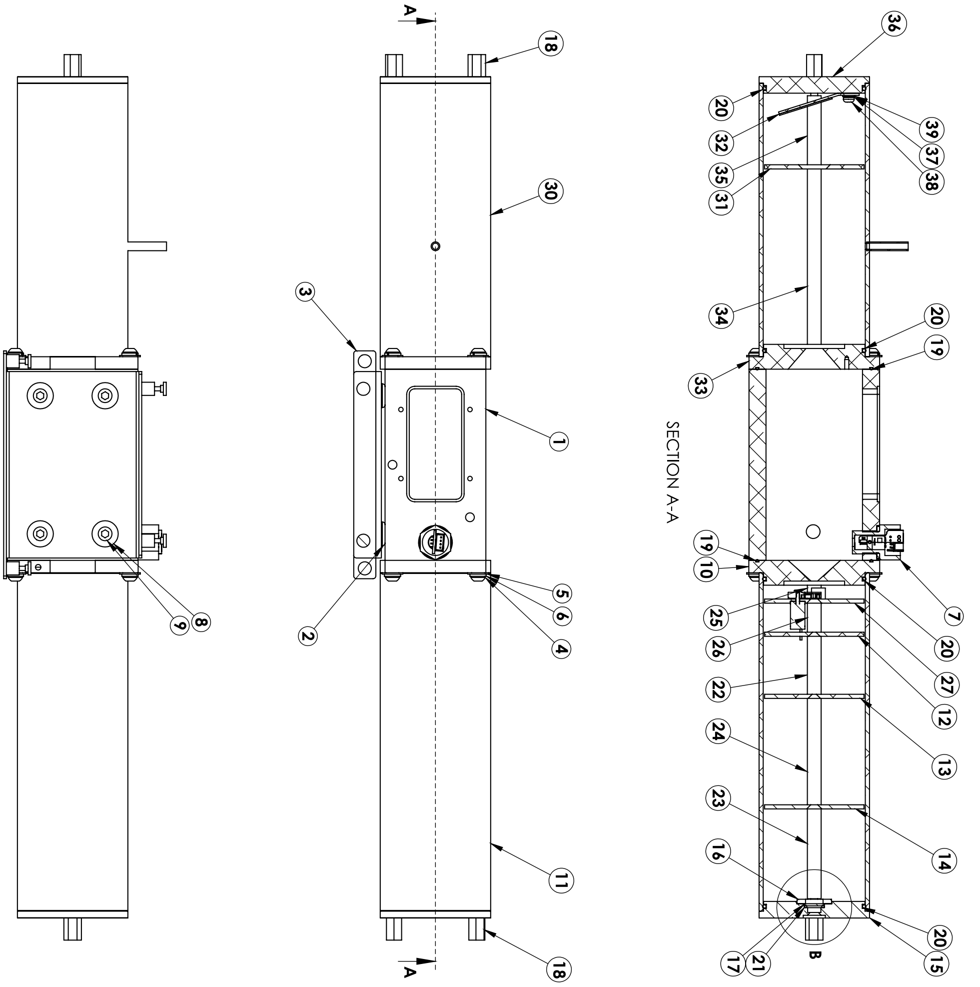
9.7 Plumbing Schematic Span Path - (PN: D020081)

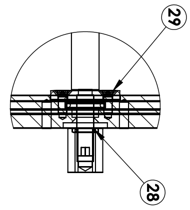


9.8 Block Wiring Schematic - (PN: D020150)



9.9 Cell Exploded View – (PN: H020670)





DETAIL B
SCALE 2 : 3

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	H020671	CELL, BODY, AURORA SYNERGY	1
2	28001142	GROMMET BUNA-N,1/4ID,5/8OD,1/1	4
3	H020672	BRACKET, CELL MOUNTING, AURORA	1
4	M6X20BH	M6x20 BUTTON HEAD SOCKET SCREW	8
5	FAS-M6SS-12	WASHER, FLAT, M6 , SS	8
6	FAS-M6SS-13	WASHER, SPRING, M6, SS	8
7	H020675	TEMP, RH & PRESSURE SENSOR ASSY, CELL, AURORA NE	1
8	6 mmx19	WASHER 0D=19 ID=6	4
9	SHCSM6BY16	BOLT, SHCS, M6x16, SS	4
10	HAR-M900364	CELL END PLATE, PMT END	1
11	HAR-M900358	80MM TUBE CASING PMT END	1
12	H020693-02	BAFFLE, 2.5mm, CELL, AURORA SYNERGY	1
13	HAR-M900352	3MM BAFFLE, M9003.	1
14	HAR-M900353	5MM BAFFLE	1
15	H020692	END PLATE, PMT, CELL, AURORA	1
16	HAR-M900373	CAP, QUARTZ WINDOW	1
17	859-073900	QUARTZ WINDOW	1
18	HAR-M900376	NUT, M6 END PLATE M9003 MACHINED BRASS	4
19	O010009 - swept	O-RING 3.0ID X 0.07W, NITRILE	2
20	ORI-1007	O-RING BS148, NITRILE	4
21	O010011	O-RING 0.426ID X 0.070W	1
22	H020011	42mm Spacer	2
23	H020013	SPACER, PMT END, CELL, 67mm, AURORA	2
24	H020014	SPACER, CELL, 77mm, AURORA	2
25	H020685	SPACER, 10mm, CELL, AURORA SYNERGY	2
26	H020686	SPACER, 21mm, CELL, AURORA SYNERGY	2
27	H020700	SHUTTER BAFFLE ASSEMBLY, CELL, AURORA NE	1
28	O010015	O-RING 1/4ID X 1/16W, VITON	4
29	FAS-M3-SS-10	M4X6 CSK PHILLIPS SCREW	3
30	H020681	TUBE, COVER, LIGHT TRAP END, CELL, AURORA	1
31	HAR-M900354	17MM BAFFLE	1
32	H040010	MIRROR ASSY, LIGHT TRAP, CELL, AURORA	1
33	H020683	CELL END PLATE, LIGHT TRAP END	1
34	H020684	SPACER, 127MM, CELL, AURORA	2
35	H020012	SPACER, LT END, CELL, 52mm, AURORA	2
36	H020682	END PLATE LIGHT TRAP END	1
37	FAS-M4SS-21	WASHER, SPRING, M4, SS	2
38	FAS-M4SS-2	M4x8 SS PAN PHILLIPS	2
39	FAS-M4SS-22	M4 FLAT WASHER, SS	2

ECN	DRAWN	DATE	CHECK	DATE	DESCRIPTION	REV.
	JAM	17/06/2022	TBE	22/06/2022	INITIAL DRAWING	A

DO NOT SCALE THIS DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN MILLIMETRES.

acoem
1492 Ferntree Gully Road
Knoxfield, Australia, 3180

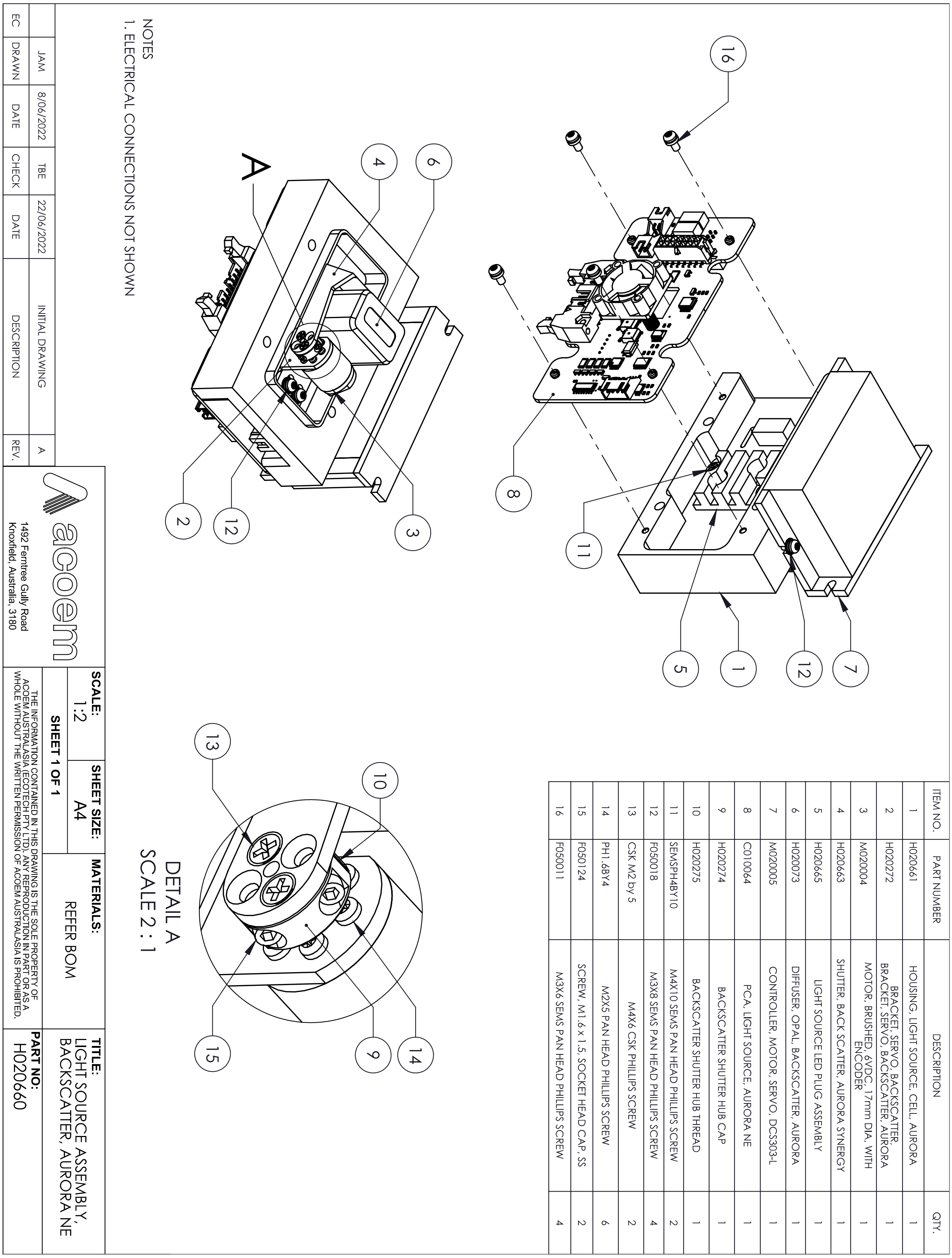
SCALE: 1:3 | SHEET SIZE: A3 | SHEET 1 OF 1

MATERIALS: SEE BOM

TITLE: CELL ASSEMBLY, AURORA NE

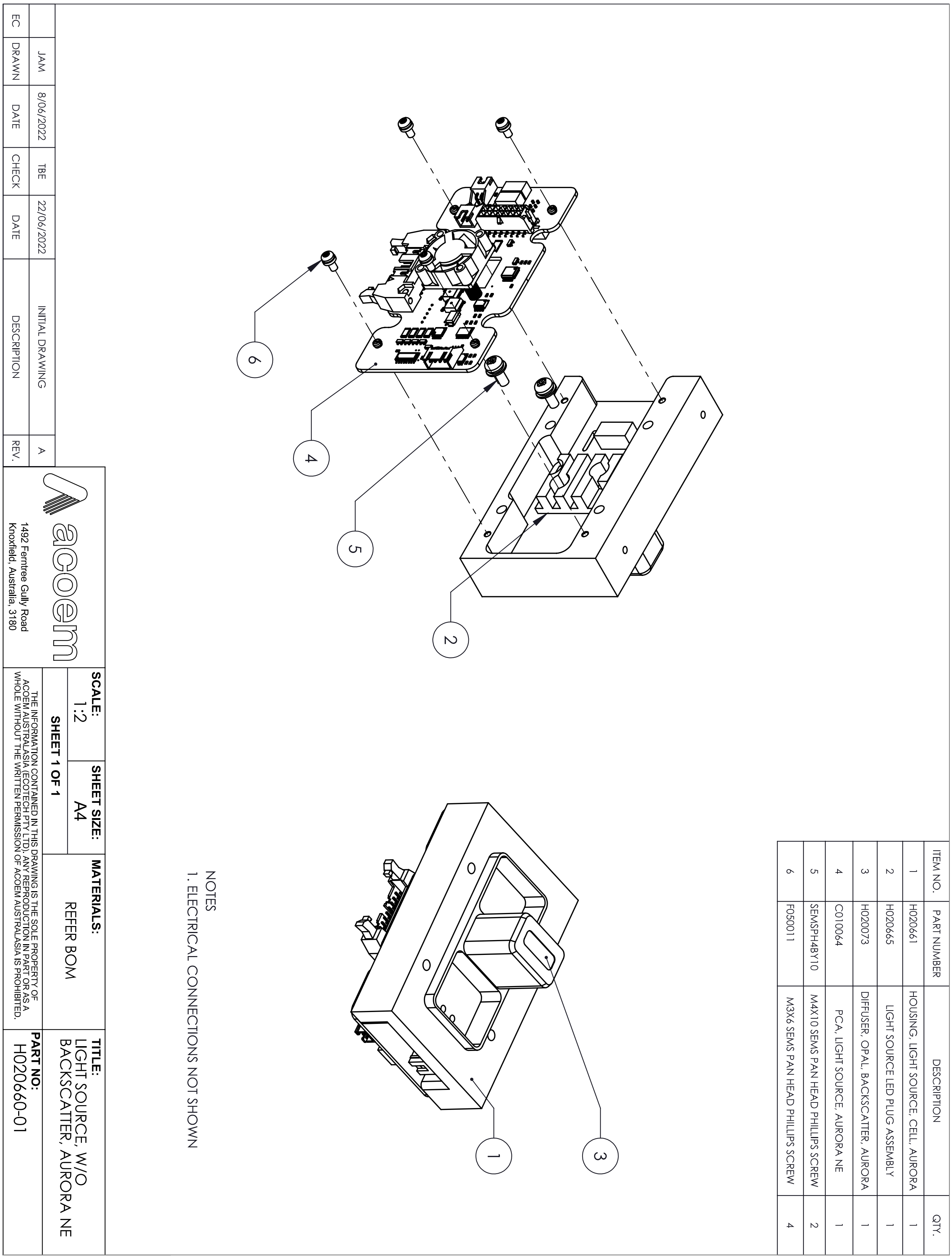
PART NO: H020670

9.10 Light Source Assembly (NE-400, NE-300) – (PN: H020660)



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	H020661	HOUSING, LIGHT SOURCE, CELL, AURORA	1
2	H020272	BRACKET, SERVO, BACKSCATTER, AURORA	1
3	M020004	MOTOR, BRUSHED, 6VDC, 17mm DIA, WITH ENCODER	1
4	H020663	SHUTTER, BACK SCATTER, AURORA SYNERGY	1
5	H020665	LIGHT SOURCE LED PLUG ASSEMBLY	1
6	H020073	DIFFUSER, OPAL, BACKSCATTER, AURORA	1
7	M020005	CONTROLLER, MOTOR, SERVO, DCS303-L	1
8	C010064	PCA, LIGHT SOURCE, AURORA NE	1
9	H020274	BACKSCATTER SHUTTER HUB CAP	1
10	H020275	BACKSCATTER SHUTTER HUB THREAD	1
11	SEMSPH4BY10	M4X10 SEMS PAN HEAD PHILLIPS SCREW	2
12	F050018	M3X8 SEMS PAN HEAD PHILLIPS SCREW	4
13	CSK M2 by 5	M4X6 CSK PHILLIPS SCREW	2
14	PH1.6BY4	M2X5 PAN HEAD PHILLIPS SCREW	6
15	F050124	SCREW, M1.6 x 1.5, SOCKET HEAD CAP, SS	2
16	F050011	M3X6 SEMS PAN HEAD PHILLIPS SCREW	4

9.11 Light Source Assembly (NE-100) – (PN: H020660-01)



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	H020661	HOUSING, LIGHT SOURCE, CELL, AURORA	1
2	H020665	LIGHT SOURCE LED PLUG ASSEMBLY	1
3	H020073	DIFFUSER, OPAL, BACKSCATTER, AURORA	1
4	C010064	PCA, LIGHT SOURCE, AURORA NE	1
5	SEMSPH4BY10	M4X10 SEMS PAN HEAD PHILLIPS SCREW	2
6	F050011	M3X6 SEMS PAN HEAD PHILLIPS SCREW	4

9.12 Sample Ball Valve Assembly – (PN: H020625)

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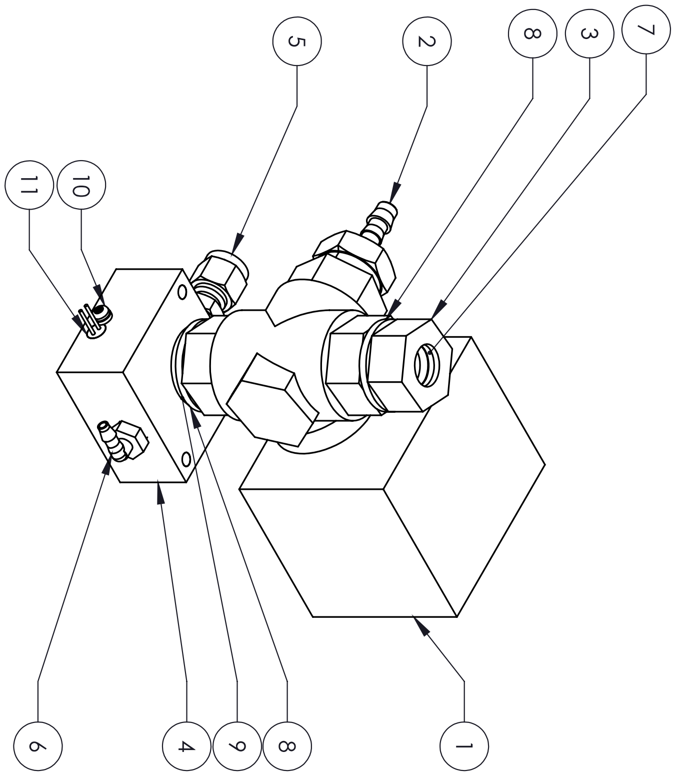

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	H020479-1	Actuated 1/2" 3-Way Ball Valve	1
2	F030119	FITTING, 1/2BSPT - 6mm BARB, NYLON, BLUE	1
3	H020622	ADAPTOR, 1/2BSPP- 1/2"TUBE	1
4	H020626	MANIFOLD, INLET, AURORA	1
5	28100402-1	FITTING, SWAGELOK, MALE CONNECTOR, 1/4T - 1/8NPT, BRASS	1
6	F030003	FITTING, BARB ELBOW, 1/8NPT - 1/8 BARB, BLACK NYLON	1
7	O010008	O-RING, VITON	2
8	F030116	WASHER, DOWTY, 1/8BSPP, NITRILE	2
9	O010049	O-RING, BS-210, VITON, DURO 90	1
10	F050011	M3X6 SEMS PAN HEAD PHILLIPS SCREW	1
11	C030275	HEATER, CARTRIDGE, 24VDC, 10W,1/4OD X 1 1/2	1

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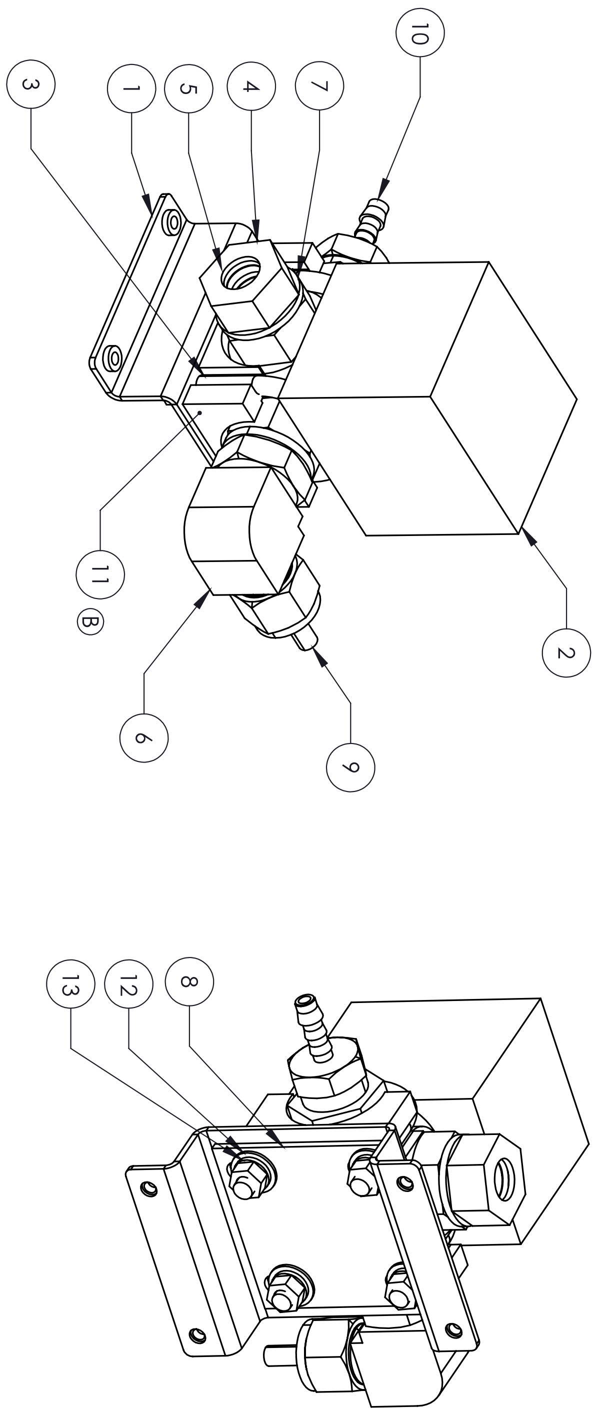
SCALE: 1:2
SHEET SIZE: A4
SHEET 1 OF 1
MATERIALS: REFER BOM
TITLE: INLET VALVE ASSEMBLY, AURORA NE
PART NO: H020625

9.13 Vent Ball Valve Assembly – (PN: H020620)



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	H020621	BRACKET, VENT/EXHAUST VALVE, AURORA SYNERGY	1
2	H020479-1	Actuated 1/2" 3-Way Ball Valve	1
3	F050145	U-BOLT, 1" NB, 1/4 UNC, SS	2
4	H020622	ADAPTOR, 1/2BSPP- 1/2" TUBE	1
5	O010008	O-RING, VITON	2
6	F030113	ELBOW, ADJUSTABLE, SWAGELOK,	1
7	F030116	WASHER, DOWTY, 1/8BSPP, NITRILE	1
8	H020623	PLATE, BACKING, VENT VALVE BRACKET, AURORA SYNERGY	1
9	28440804-1	FITTING, SWAGELOK, PORT CONNECTOR, 1/2T - 1/4 STUB, BRASS	1
10	F030119	FITTING, 1/2BSPT - 6mm BARB, NYLON, BLUE	1
B 11	H020624	CRADLE, BALL VALVE, AURORA NE	1
B 12	FAS-M6SS-12	WASHER, FLAT, M6 , SS	4
B 13	FAS-M6SS-13	WASHER, SPRING, M6, SS	4

EC	DRAWN	DATE	CHECK	DATE	DESCRIPTION	REV.
7533	JAM	15/09/2022	TBE	3/11/2022	ADDED CRADLE BRACKET AS PER ECN	B
	JAM	13/05/2022	TBE	20/06/2022	INITIAL DRAWING	A

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1492 Ferntree Gully Road
Knoxfield, Australia, 3180

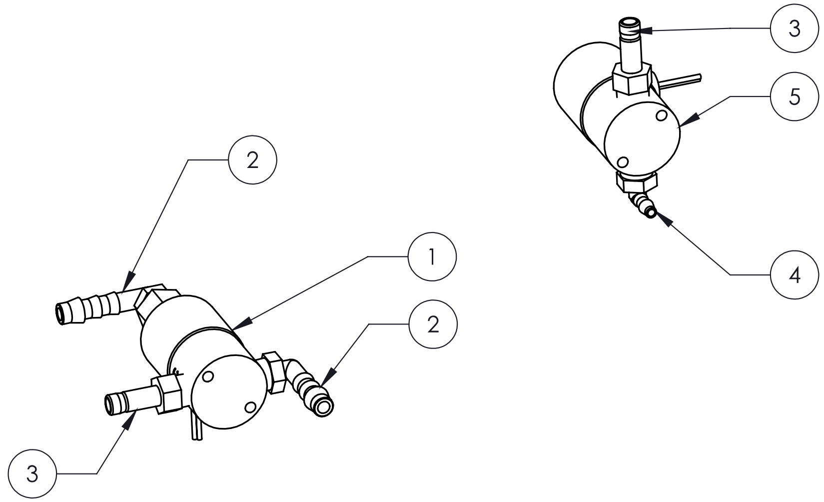
SCALE: 1:2
SHEET SIZE: A4
SHEET 1 OF 1
MATERIALS: REFER BOM
TITLE: VALVE ASSEMBLY, EXHAUST/VENT, AURORA
PART NO: H020620

9.14 Span & Zero Solenoid Valve Assembly – (PN: H020630)

NOTES

1. VALVES NOT SHOWN IN SITU
2. 28590402-1 COME PRE SWAGED WITH NUT AND FERRULE (NOT SHOWN)
3. ELECTRICAL CONNECTOR NOT SHOWN
4. VALVE ASSEMBLY IS SUPPLIED CLEANED, ASSEMBLED AND TESTED

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	H020464	3-Way Kip Valve 5/32" Orifice	1
2	F030118	FITTING, MALE ELBOW, 6mm BARB - 1/8BSPT, NYLON, BLUE	2
3	28590402-1	FITTING SWAGELOK MALE ADAPTOR 1/4T STUB - 1/8NPT BRASS	2
4	F030003	FITTING, BARB ELBOW, 1/8NPT - 1/8 BARB, BLACK NYLON	1
5	45000177	VALVE 2 WAY 12VDC	1



EC	DRAWN	DATE	CHECK	DATE	DESCRIPTION	REV.
	JAM	7/06/2022	TBE	20/06/2022	INITIAL DRAWING	A

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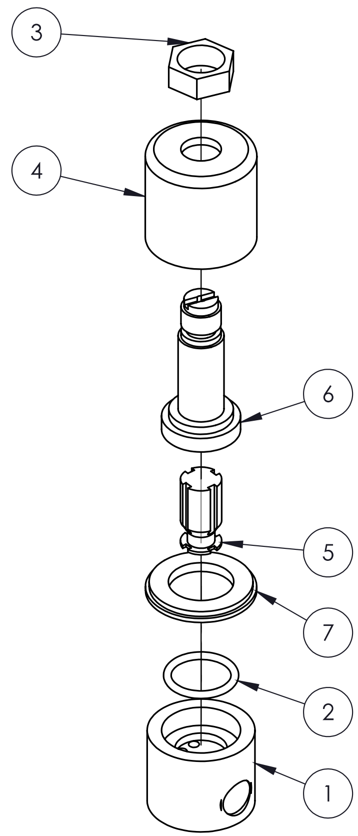
1492 Ferntree Gully Road
Knoxfield, Australia, 3180

SCALE: 1:2
SHEET SIZE: A4
SHEET 1 OF 1
MATERIALS: REFER BOM
TITLE: SPAN & ZERO VALVE ASSEMBLY, AURORA NE
PART NO: H020630

9.15 Solenoid Valve 2 way – (PN: 45000177)

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	BASE	BASE, VALVE, 2 WAY, 12 VDC	1
2	O010023	O-RING BS038, SILICONE	1
3	NUT	NUT, VALVE, 2 WAY, 12 VDC	1
4	COIL	SOLENOID COIL, VALVE, 2 WAY, 12 VDC	1
5	PLUNGER	PLUNGER, VALVE, 2 WAY, 12 VDC	1
6	STEM	STEM, VALVE, 2 WAY, 12 VDC	1
7	WASHER	WASHER, VALVE, 2 WAY, 12 VDC	1



STEPS TO REPLACE O-RINGS:

1. SECURE THE 2-WAY VALVE UPRIGHT INTO A LARGE VICE WITH PROTECTION AROUND ITS BODY TO PREVENT SCRATCH OR DAMAGE TO VALVE
2. REMOVE NUT FROM THE TOP OF THE 3-WAY VALVE USING A 9/16" SPANNER
3. LIFT OFF THE SOLENOID COIL FROM THE 2-WAY VALVE THEN UNSCREW THE SHAFT FROM THE BASE USING ACOEM TOOL #T030010. WHILE UNSCREWING TAKE CARE THAT THE INTERNAL PLUNGER DOES NOT FALL OUT
4. REPLACE THE INTERNAL O-RING WITH O010023
5. ASSEMBLE THE SHAFT ALONG WITH PLUNGER BACK IN ITS POSITION AND TIGHTEN USING TOOL TO 45IN/LB.
6. ASSEMBLE THE SOLENOID ONTO THE VALVE.
7. REPLACE THE NUT AND TIGHTEN TO 20IN/LB.

EC	DRAWN	DATE	CHECK	DATE	DESCRIPTION	REV.
	JAM	8/12/2022	MLT	8/12/2022	INITIAL DRAWING	A

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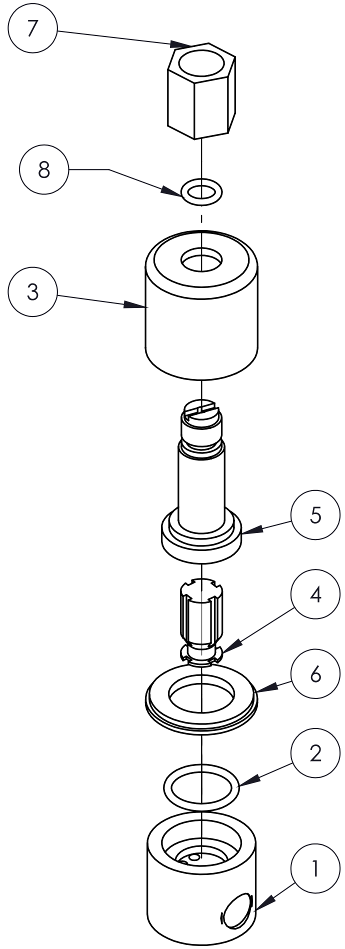
Knoxfield, Australia, 3180

SCALE: 2:3
SHEET SIZE: A4
SHEET 1 OF 1
MATERIALS: REFER BOM
TITLE: VALVE, 2 WAY, 12VDC, BASE MOUNTED
PART NO: 45000177

9.16 Solenoid Valve 3 Way – (PN: H020464)

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	BASE	BASE, VALVE, 3 WAY, 12 VDC	1
2	O010023	O-RING BS038, SILICONE	1
3	COIL	SOLENOID COIL, VALVE, 3 WAY, 12 VDC	1
4	PLUNGER	PLUNGER, VALVE, 3 WAY, 12 VDC	1
5	STEM	STEM, VALVE, 3 WAY, 12 VDC	1
6	WASHER	WASHER, VALVE, 3 WAY, 12 VDC	1
7	NUT	NUT, 1/8NPT, 3 WAY VALVE	1
8	O010015	O-RING 1/4ID X 1/16W, VITON	1



STEPS TO REPLACE O-RINGS:

1. SECURE THE 3-WAY VALVE UPRIGHT INTO A LARGE VICE WITH PROTECTION AROUND ITS BODY TO PREVENT SCRATCH OR DAMAGE TO VALVE
2. REMOVE NUT FROM THE TOP OF THE 3-WAY VALVE USING A 9/16" SPANNER
3. REMOVE THE SMALL O-RING FROM THE STEM USING A SEAL PICK
4. LIFT OFF THE SOLENOID COIL FROM THE 3-WAY VALVE THEN UNSCREW THE SHAFT FROM THE BASE USING ACOEM TOOL #T030010.
   WHILE UNSCREWING TAKE CARE THAT THE INTERNAL PLUNGER DOES NOT FALL OUT
5. REPLACE THE INTERNAL O-RING WITH O010023
6. ASSEMBLE THE SHAFT ALONG WITH PLUNGER BACK IN ITS POSITION AND TIGHTEN USING TOOL TO 45IN/LB.
7. ASSEMBLE THE SOLENOID TO THE VALVE
8. REPLACE THE SMALL EXTERNAL O-RING WITH O010015
9. REPALCE THE NUT AND TIGHTEN TO 20IN/LB.

EC	DRAWN	DATE	CHECK	DATE	DESCRIPTION	REV.
	JAM	8/12/2022	MLT	8/12/2022	INITIAL DRAWING	A

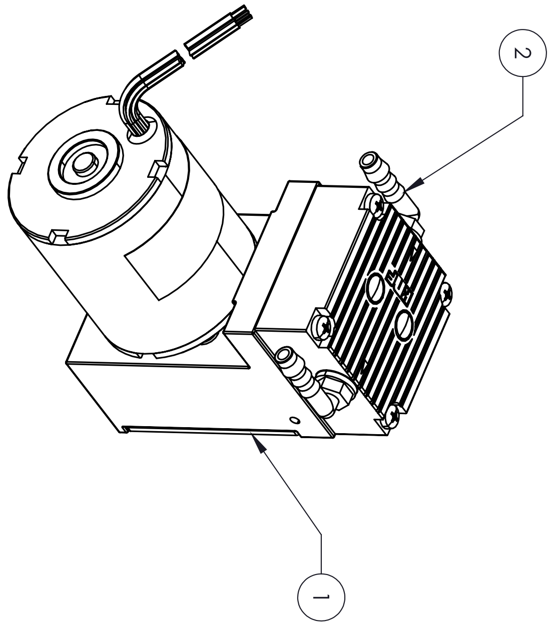
acoem
1492 Ferntree Gully Road
Knoxfield, Australia, 3180

SCALE:	SHEET SIZE:	MATERIALS:	TITLE:
2:3	A4	REFER BOM	VALVE, 3 WAY, 12VDC, KIP, BASE MOUNTED
SHEET 1 OF 1			PART NO: H020464

9.17 Internal Sample Pump Assembly – (PN: H020635)

NOTES

1. ELECTRICAL CONNECTOR NOT SHOWN
2. PUMP ASSEMBLED IS SUPPLIED ASSEMBLED AND TESTED



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	P030021	PUMP, DIAPHRAGM, KNF, 24V BLDC	1
2	F030118	FITTING, MALE ELBOW, 6mm BARB - 1/8BSPT, NYLON, BLUE	2

EC	DRAWN	DATE	CHECK	DATE	DESCRIPTION	REV.
	JAM	8/06/2022	TBE	22/06/2022	INITIAL DRAWING	A

acoem

1492 Ferntree Gully Road
Knoxfield, Australia, 3180

SCALE: 1:2

SHEET SIZE: A4

SHEET 1 OF 1

MATERIALS: REFER BOM

TITLE: PUMP ASSEMBLY, AURORA NE

PART NO: H020635

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Appendix A. Acoem Protocol

Add appendix details:

A.1 Packet Format

All Serial, USB, and Network requests sent to the Instrument and received in response from the instrument will be in the following packet format to ensure data is reliable.

Differences from Advanced Protocol command

- Message length field is denominated in bytes, not parameters
- Message length field is 2 bytes instead of 1
- Maximum message length is 4,000 bytes instead of 255
- Checksum is calculated across the entire message, excluding only the checksum and EOT bytes
- Commands are reordered and many legacy commands are no longer supported

Table 16 – Acoem Protocol Packet Format

Byte Number	1	2	3	4	5..6	7..10	11	12
Description	STX	Serial ID	Command	ETX	Message Length MSB…LSB	Message Data MSB…LSB	Checksum	EOT

Data is sent in Big-endian format; that is, the most significant byte is the first byte, followed by the less significant bytes. This is the same format that is used in the regular Advanced Protocol when sending multi-byte data such as IEEE representation of floating point numbers.

Where:

<STX>	ASCII Start of Text = 0x02 hex.
Serial ID	The Serial ID, a feature intended to support Multi-drop serial communications. This allows sending a command on a shared serial line and only getting a response from the correct instrument. For simplicity, a command with a Serial ID 0 will affect all listening instruments, regardless of their Serial ID setting.
<ETX>	ASCII End of Text = 0x03 hex.
Message length	Number of bytes in the message data. Typically a multiple of 4.
Checksum	XOR of the all bytes except Checksum and EOT.
<EOT>	ASCII End of Transmission = 0x04 hex.

Example

A basic request for Primary gas data would be as follows:

Table 17 – Example: Acoem Protocol Primary Gas Request

Byte Number	Description	Value	Checksum
1	STX	2	0⊕2=2
2	Serial ID	0	2⊕0=2
3	Command	4	?
4	ETX	3	?
5	Message length MSB	0	?
6	Message length LSB	4	?
7	Parameter ID MSB	0	?
8	Parameter ID MSB-1	0	?
9	Parameter ID MSB-2	0	?
10	Parameter ID LSB	50	?
11	Checksum	54	
12	EOT	4	

And a sample response:

Table 18 – Example: Acoem Protocol Primary Gas Response

Byte Number	Description	Value	Checksum
1	STX	2	0⊕2=2
2	Serial ID	0	2⊕0=2
3	Command	4	?
4	ETX	3	?
5	Message length MSB	0	?
6	Message length LSB	8	?
7	Parameter ID MSB	0	?
8	Parameter ID MSB-1	0	?
9	Parameter ID MSB-2	0	?
10	Parameter ID LSB	50	?
7	Parameter Value MSB (IEEE representation of 1.0)	63	?
8	Parameter Value MSB-1	128	?
9	Parameter Value MSB-2	0	?

Byte Number	Description	Value	Checksum
10	Parameter Value LSB	0	?
11	Checksum	133	
12	EOT	4	

A.2 List of Commands

Table 19 – List of Commands

Cmd#	Name	Description
0	Error	Error message from the instrument
1	Get Instrument Type	Returns the model and options for an analyser.
2	Get Version	Returns the instrument firmware version.
3	Reset	Restarts the analyser
4	Get Values	Returns the current value of various analyser parameters.
5	Set Values	Sets various analyser parameters.
6	Get Logging Config	Returns all the parameters currently being logged
7	Get Logged Data	Used to collect historical data from the instrument

A.3 Commands

A.3.1 Error (0)

If the command byte of a response is 0, it indicates an error has occurred.

Table 20 – Format: Communication Error

Byte Number	Description	Value
1	STX	2
2	Serial ID	varies
3	Command	0
4	ETX	3
5	Message length MSB	0
6	Message length LSB	4
7	Error code MSB	n
8	Error code LSB	n
9	Checksum	varies
10	EOT	4

Table 21 – Error Codes

Err #	Description
0	Checksum failed
1	Invalid command byte
2	Invalid parameter
3	Invalid message length
4	Reserved
5	Reserved
6	Reserved
7	Reserved
8	Media not connected
9	Media busy

Table 22 – Example: Error Response

Byte Number	Description	Value	Checksum
1	STX	2	$0 \oplus 2=2$
2	Serial ID	0	$2 \oplus 0=2$
3	Command	0	$2 \oplus 0=2$
4	ETX	3	$2 \oplus 3=1$
5	Message length MSB	0	$1 \oplus 0=1$
6	Message length LSB	4	$1 \oplus 4=5$
7	Error code MSB	0	$5 \oplus 0=5$
8	Error code LSB (0 = Bad checksum)	0	$5 \oplus 0=5$
9	Checksum	5	
10	EOT	4	

A.3.2 Get Instrument Type (1)

This command requests details on the type of analyser being communicated with.

Differences from Advanced Protocol command

- The Advanced Protocol command sent bytes instead of 4-byte words.

A.3.2.1 Command

The message length must be zero.

Table 23 – Format: Get Instrument Type Command

Byte Number	Description	Value
1	STX	2
2	Serial ID	varies
3	Command	1
4	ETX	3
5	Message length MSB	0
6	Message length LSB	0
7	Checksum	varies
8	EOT	4

A.3.2.2 Response

The response is 4 integers: Model, Variant, Sub-Type, and Range.

Table 24 – Format: Get Instrument Type Response

Byte Number	Description	Value
1	STX	2
2	Serial ID	varies
3	Command	1
4	ETX	3
5	Message length MSB	0
6	Message length LSB	16
7	Model MSB	n
8	Model MSB-1	n
9	Model MSB-2	n
10	Model LSB	n
11	Variant MSB	n
12	Variant MSB-1	n
13	Variant MSB-2	n
14	Variant LSB	n
15	Sub-type MSB	n
16	Sub-type MSB-1	n
17	Sub-type MSB-2	n
18	Sub-type LSB	n
19	Range MSB	n

Byte Number	Description	Value
20	Range MSB-1	n
21	Range MSB-2	n
22	Range LSB	n
23	Checksum	varies
24	EOT	4

Table 25 – Aurora Instrument Types

Serinus	Value
Model	158
Variant	1100 3100 4100
Sub-type	0
Range	0

Table 26 – Serinus Instrument Types

Serinus	Value
Model	131
Variant	10 = S10 30 = S30 40 = S40 50 = S50 60 = S60 200 = Serical
Sub-type	0 = S10, S30, S40, S50, Serical 1000 1 = S11, S31, S51, Serical 2000 2 = S42, Serical 3000 3 = S43, S53 4 = S44, S54 5 = S55 6 = S56 7 = S57
Range	0 = Standard 1 = High 2 = Trace

A.3.3 Get Version (2)

This command requests the current firmware version running on the analyser.

Additional Differences from Advanced Protocol command

- The Advanced Protocol command responded with major, minor, and revision numbers.

A.3.3.1 Command

The message field must be empty. The response is a 4 byte unsigned integer Build number and an 4 byte integer Branch number.

Table 27 – Format: Get Version Command

Byte Number	Description	Value
1	STX	2
2	Serial ID	varies
3	Command	2
4	ETX	3
5	Message length MSB	0
6	Message length LSB	0
7	Checksum	varies
8	EOT	4

A.3.3.2 Response

Table 28 – Format: Get Version Response

Byte Number	Description	Value
1	STX	2
2	Serial ID	varies
3	Command	2
4	ETX	3
5	Message length MSB	0
6	Message length LSB	8
7	Build MSB	0
8	Build MSB-1	0
9	Build MSB-2	0
10	Build MSB	0
11	Branch MSB	0
12	Branch MSB-1	0

Byte Number	Description	Value
13	Branch MSB-2	0
14	Branch MSB	0
15	Checksum	varies
16	EOT	4

A.3.4 Reset (3)

This command forces the analyser to do a full restart. The message field must contain the exact string “Really” to ensure spurious rests aren’t received.

Differences from Advanced Protocol command

- The Advanced Protocol command sent a zero message length response before restarting.

A.3.4.1 Command

Table 29 – Format: Reset Command

Byte Number	Description	Value
1	STX	2
2	Serial ID	varies
3	Command	3
4	ETX	3
5	Message length MSB	0
6	Message length LSB	6
7	Checksum	’R’
8	Checksum	’E’
9	Checksum	’A’
10	Checksum	’L’
11	Checksum	’L’
12	Checksum	’Y’
13	Checksum	varies
14	EOT	4

A.3.4.2 Response

There is no response to this command.

A.3.5 Get Values (4)

This command requests the value of one or more instrument parameters.

Differences from Advanced Protocol command

The Advanced Protocol command sent id/value pairs instead of just values

A.3.5.1 Command

The message field contains the 4-byte indexes of the requested parameter, as described in the List of Parameters (hence the message length must be at least 4). Up to 500 indexes can be sent in a single message (a maximum message length of 2,000).

Table 30 – Format: Get Values (X values)

Byte Number	Description	Value
1	STX	2
2	Serial ID	varies
3	Command	4
4	ETX	3
5	Message length MSB	4 * X
6	Message length LSB	
7	Parameter 1 ID MSB	n
8	Parameter 1 ID MSB-1	n
9	Parameter 1 ID MSB-2	n
10	Parameter 1 ID LSB	n
…	Repeat X times	…
…	Checksum	varies
…	EOT	4

A.3.5.2 Response

All parameters respond with the 4-byte value (either IEEE or integer), depending on the parameter.

Table 31 – Format: Get Values Response (X values)

Byte Number	Description	Value
1	STX	2
2	Serial ID	varies
3	Command	4
4	ETX	3
5	Message length MSB	4 * X
6	Message length LSB	
7	Parameter Value MSB	n
8	Parameter Value MSB-1	n

9	Parameter Value MSB-2	n
10	Parameter Value LSB	n
…	Repeat X times	…
…	Checksum	varies
…	EOT	4

Example

This command requests parameter 1 twice (purely for demonstration), which is the current time and date on any instruments. It has a serial ID of 0, a message length of 8 bytes, and a checksum of 8.

Table 32 – Example: Get Values Request

Byte Number	Description	Value	Checksum
1	STX	2	0⊕2=2
2	Serial ID	0	2⊕0=2
3	Command	4	?
4	ETX	3	?
5	Message length MSB	0	?
6	Message length LSB	8	?
7	Parameter 1 ID MSB	0	?
8	Parameter 1 ID MSB-1	0	?
9	Parameter 1 ID MSB-2	0	?
10	Parameter 1 ID LSB	1	?
11	Parameter 2 ID MSB	0	?
12	Parameter 2 ID MSB-1	0	?
13	Parameter 2 ID MSB-2	0	?
14	Parameter 2 ID LSB	1	?
15	Checksum	4	
16	EOT	4	

Table 33 – Example: Get Values Response

Byte Number	Description	Value	Checksum
1	STX	2	0⊕2=2
2	Serial ID	0	2⊕0=2
3	Command	4	?
4	ETX	3	?
5	Message length MSB	0	?

Byte Number	Description	Value	Checksum
6	Message length LSB	16	?
7	Parameter 1 Value MSB	?	?
8	Parameter 1 Value MSB-1	?	?
9	Parameter 1 Value MSB-2	?	?
10	Parameter 1 Value LSB	?	?
11	Parameter 2 Value MSB	?	?
12	Parameter 2 Value MSB-1	?	?
13	Parameter 2 Value MSB-2	?	?
14	Parameter 2 Value LSB	?	?
15	Checksum	?	
16	EOT	4	

A.3.6 Set Values (5)

This command sets the value of an instrument parameter.

A.3.6.1 Command

The message field contains the 4-byte index of the requested parameter, as described in the List of Parameters, followed by the 4-byte value to set the parameter to (in other words, the Set Value command format looks exactly like the Get Value response, but with a different command number).

Up to 500 indexes can be supplied in a single request. Most (but not all) parameters can be set.

A.3.6.2 Response

There is no response to this command.

A.3.7 Get Logging Config (6)

This command returns the list of parameter IDs currently being logged. It is sent with zero message data length.

The first 4 byte word of the response data is the number of fields being logged (0..500); each following 4 byte word is the ID of the parameter.

A.3.7.1 Command

Table 34 – Format: Get Logging Config Command

Byte Number	Description	Value
1	STX	2
2	Serial ID	varies
3	Command	6

Byte Number	Description	Value
4	ETX	3
5	Message length MSB	0
6	Message length LSB	0
7	Checksum	varies
8	EOT	4

A.3.7.2 Response

Table 35 – Format: Get Logging Config Response

Byte Number	Description	Value
1	STX	2
2	Serial ID	varies
3	Command	6
4	ETX	3
5	Message length MSB	0..500
6	Message length LSB	
7	Parameter Count MSB	n
8	Parameter Count MSB-1	n
9	Parameter Count MSB-2	n
10	Parameter Count LSB	n
11	Parameter 1 ID MSB	n
12	Parameter 1 ID MSB-1	n
13	Parameter 1 ID MSB-2	n
14	Parameter 1 ID LSB	n
…	Repeat for N parameters	…
…	Checksum	varies
…	EOT	4

A.3.8 Get Logged Data (7)

This command requests all logged data over a specific date range.

Additional Differences from Advanced Protocol command

- All fields are 4 bytes (the old protocol used 1 byte field count, 1 byte IDs and 3 byte values)
- The timestamp proceeds the field count (instead of the other way around)
- Logging Period and Instrument Operation are new fields that precede the timestamp

- Header information and data are sent as separate records

A.3.8.1 Command

For the initial command, the message length is 8, with the first four bytes being the start date and the last the end date. Both times are in the Time Stamp format (see below). After that there are three different forms of the command to get the next data, repeat the last block, or cancel the download; each of these forms only has a message length of 4.

After initiating a download, send the Get Logged Data command with a single 4 byte message to either receive the next packet of records (0), repeat the previous packet (1), or cancel the download (2).

When there are no more data records in the requested range, the receive next packet command returns a Retrieve Data command with a zero length message field. Subsequent requests for next, last, or cancel will return the INVALID_PARAMETER error.

Note: The data will be retrieved from the USB or SD card as dictated by the instrument's current logging set-up.

Table 36 – Format: Get Logged Data Initial Request

Byte Number	Description	Value
1	STX	2
2	Serial ID	varies
3	Command	7
4	ETX	3
5	Message length MSB	0
6	Message length LSB	8
7	Start Timestamp MSB	?
8	Start Timestamp MSB-1	?
9	Start Timestamp MSB-2	?
10	Start Timestamp LSB	?
11	End Timestamp MSB	?
12	End Timestamp MSB-1	?
13	End Timestamp MSB-2	?
14	End Timestamp LSB	?
15	Checksum	varies
16	EOT	4

Table 37 – Format: Get Logged Data Command

Byte Number	Description	Value
1	STX	2
2	Serial ID	varies
3	Command	7
4	ETX	3
5	Message length MSB	0
6	Message length LSB	4
7	Command MSB	0
8	Command MSB-1	0
9	Command MSB-2	0
10	Command LSB	varies
11	Checksum	varies
12	EOT	4

Table 38 – Get Logged Data Commands

Err #	Description
0	Next packet When there are no more data records in the requested range, the Send Next command returns a Retrieve Data command with a zero length message field.
1	Repeat last packet If a packet fails its checksum test, then it can be easily be re-sent (as many times as necessary). However, only the last packet can be re-sent; to request other packets it is necessary to restart the download.
2	Cancel download There is no response to this command. It is not necessary to terminate a download, as sending any other command will cancel the download and execute the new command (this includes sending the initial Get Logged Data command, or a download request with a different range: they will be treated as new commands).

Table 39 – Example: Get Logged Data Initial Request

Byte Number	Description	Value	Checksum
1	STX	2	$0\oplus2=2$
2	Serial ID	0	$2\oplus0=2$
3	Command	7	?
4	ETX	3	?
5	Message length MSB	0	?

Byte Number	Description	Value	Checksum
6	Message length LSB	8	?
7	Start Timestamp MSB	?	?
8	Start Timestamp MSB-1	?	?
9	Start Timestamp MSB-2	?	?
10	Start Timestamp LSB	?	?
11	End Timestamp MSB	?	?
12	End Timestamp MSB-1	?	?
13	End Timestamp MSB-2	?	?
14	End Timestamp LSB	?	?
15	Checksum	?	
16	EOT	4	

Table 40 – Example: Get Logged Data Next Record Request

Byte Number	Description	Value	Checksum
1	STX	2	0⊕2=2
2	Serial ID	0	2⊕0=2
3	Command	7	?
4	ETX	3	?
5	Message length MSB	0	?
6	Message length LSB	4	?
7	Command MSB	0	?
8	Command MSB-1	0	?
9	Command MSB-2	0	?
10	Command LSB (0 = next packet) (1 = repeat previous packet) (2 = cancel download)	0	?
11	Checksum	2	
12	EOT	4	

A.3.8.2 Response

The response is a list of records; each record starts with a record type, instrument operation, two reserved bytes, timestamp, logging period, field count, and then a number of id or value fields equal to the field count. There may be multiple records in a single response (up to the message length of 4,000 bytes).

Most values are 4 bytes, though the record type, instrument operation, and reserved fields are single bytes; the timestamp is in Time Stamp format; the field count is the number of parameter ID or Value fields; parameter IDs are integers; parameter Values are IEEE floating point numbers, signed integers, or unsigned integers as specified by the List of Parameters.

The message length of the packet is the total byte count for entirety of the message payload (including the field count and record count/operation/reserved bytes/timestamp/period). The message field must be parsed to determine how many records are contained in it. The end of a record is signified only by the timestamp for the next record.

A packet may not contain all 4K of message data. This could be because the next record was too large to fit into the current packet, or because the date range has been exhausted and there are no more records to send. The only way to distinguish between these cases is to request the next packet: if that returns with zero length message data, then the date range is completed (otherwise it will return with more records).

It is important to note there are two kinds of records, header and data.

Header Records

The first record sent will always be a header record. This means it has 001 in the record type field. Every following data parameter is a parameter ID, used to identify the data fields in the data records.

It is possible to receive multiple header records in a single packet. It is also possible to receive header records with no following data records if no data was logged before the user changed the configuration.

Note that the parameter IDs returned will vary depending on what was logged; each individual record can contain up to 500 IDs in any combination.

The timestamp, logging period, and instrument operation fields of a header record are undefined and should not be used.

Data Records

Once a header record is received, data records (where the record type field is 000) will contain data that corresponds to the header information. Each field must be interpreted according to its specified data type.

If the logged data changes, then the instrument will send a new header record.

Calibration Records

In addition to logging records every specified interval, the completion of a calibration state (zero or span/calibration or check) will log a unique data record with an appropriate CURRENT_OPERATION value. Note that if logging is completely disabled, these calibration records are also disabled.

Table 41 – Format: Get Logged Data Response

Byte Number	Description	Value
1	STX	2
2	Serial ID	varies

Byte Number	Description	Value
3	Command	7
4	ETX	3
5	Message length MSB	0
6	Message length LSB	varies
7	Record 1 Record Type (0 or 1)	n
8	Record 1 Instrument Operation	n
9	Record 1 Reserved for future expansion	n
10	Record 1 Reserved for future expansion	n
11	Record 1 Timestamp MSB	n
12	Record 1 Timestamp MSB-1	n
13	Record 1 Timestamp MSB-2	n
14	Record 1 Timestamp LSB	n
15	Record 1 Logging Period MSB	n
16	Record 1 Logging Period MSB-1	n
17	Record 1 Logging Period MSB-2	n
18	Record 1 Logging Period LSB	n
19	Record 1 Number of ID/Value fields MSB	n
20	Record 1 Number of ID/Value fields MSB-1	n
21	Record 1 Number of ID/Value fields MSB-2	n
22	Record 1 Number of ID/Value fields LSB	n
23	Record 1 Parameter 1 ID or Value MSB	n
24	Record 1 Parameter 1 ID or Value MSB-1	n
25	Record 1 Parameter 1 ID or Value MSB-2	n
26	Record 1 Parameter 1 ID or Value LSB	n
…	Repeat for N Parameter ID or Value fields	…
…	Repeat for N Records	…
…	Checksum	varies
…	EOT	4

Table 42 – Format: Get Logged Data Response (no more records)

Byte Number	Description	Value
1	STX	2
2	Serial ID	varies
3	Command	7

Byte Number	Description	Value
4	ETX	3
5	Message length MSB	0
6	Message length LSB	0
7	Checksum	varies
8	EOT	4

A response of 2 records with 2 parameters, might look like this:

Table 43 – Example: Get Logged Data Response

Byte sequence	Description
002 000 007 003	Header information (STX, serial ID, command, ETX)
000 064	Message length (64 bytes)
001	Record type –001 for header. The first record for a data download request will always be a header record.
000	Instrument Operation. For a header record this should be ignored.
000	Reserved for future operation.
000	Reserved for future operation.
? ? ? ?	Timestamp of record. For a header record this should be ignored.
000 000 000 000	Logging period (in seconds). For a header record this should be ignored.
000 000 000 002	Number of parameter ID fields to follow.
000 024 243 018	ID of first parameter
000 000 019 138	ID of second parameter
000	Record type –000 for data. This is the start of the first data record.
000	Instrument Operation. This value is the same as CURRENT_OPERATION.
000	Reserved for future expansion.
000	Reserved for future expansion.
? ? ? ?	Timestamp of first data record
000 000 000 000	Logging period (in seconds). This value is the same as DATALOG_PARAM_INTERVAL_SECONDS. Note that calibration data always has a period of 0.
000 000 000 002	Number of parameter value fields to follow

Byte sequence	Description
063 140 204 205	Floating point value of first parameter
064 012 204 205	Floating point value of second parameter
000	Record type –000 for data. This is the start of the second data record.
000	Instrument Operation. This value is the same as CURRENT_OPERATION.
000	Reserved for future expansion.
000	Reserved for future expansion.
? ? ? ?	Timestamp of second data record
000 000 000 000	Logging period (in seconds). This value is the same as DATALOG_PARAM_INTERVAL_SECONDS. Note that calibration data always has a period of 0.
000 000 000 002	Number of parameter value fields to follow
063 140 204 205	Floating point value of first parameter
064 012 204 205	Floating point value of second parameter
? 004	Checksum and EOT

A.4 List of Aurora Parameters

The Aurora exclusively uses the Expanded Advanced Protocol to report parameters and download data, as it has a very long list of reportable values. Note that measurement parameters are not listed by ID, as there are too many of them; rather, a formula is provided for constructing the ID of measurement parameters (see Constructed Parameters, below).

All of these parameters can be requested with Get Values; a limited subset of them can be logged to the USB flash drive for later downloading via the Retrieve Data command.

Parameters are either Float, Signed, or Unsigned. Note that all parameters are 4 bytes, from MSB to LSB.

Table 44 – Aurora data types

Data type	Description
Float	IEEE floating point representation
Signed	Signed 32-bit integer
Unsigned	Unsigned 32-bit integer

The current list of parameters follows. Note that this list may be added to, particularly for troubleshooting and diagnostics.

Constructed Parameters

The Aurora has a vast array of measurement parameters. Rather than list every single possible ID, a formula is used to calculate the ID for measurement parameters.

Parameter ID = Base ID * 1,000,000 + Wavelength * 1,000 + Angle

Thus, the ID 1635000 corresponds to the Sigma for wavelength 635 nm at 0 degrees; 6520090 would be the measure ratio for wavelength 520 degrees at angle 90.

The Aurora 1000 and 3000 log Fullscatter and Backscatter instead of degree. They use the same equation, substituting an angle value for Fullscatter and Backscatter.

Fullscatter = 0 degrees

Backscatter = 90 degrees

Thus ID 1635000 is the Fullscatter Sigma for wavelength 635 on an Aurora 1000 or 3000; 1635090 would be the Backscatter Sigma.

Note that not all of these IDs are valid at any given time; the Aurora can only return a value for wavelengths or angles it is actually measuring. The parameters WAVELENGTH_1..3 will return the wavelengths installed, and the parameter ANGLE_1..20 will return the current angles being measured.

When downloading stored data, the parameter ID will always be for the data as it was taken.

The base IDs include all of the stages of the calculation of the sigma reading for troubleshooting and diagnostics. Most users will only be interested in the Sigma or Measure Ratio.

Table 45 – Aurora Base IDs for Constructed Parameters

Base ID	Description	Data type	Notes
1	Sigma	Float	The scattering value
2	Sigma (Kalman)	Float	The scattering value with a Kalman filter applied
3	Sigma (1 min)	Float	The scattering value with a 1 minute filter
4	Sigma (5 min)	Float	The scattering value with a 5 minute filter
5	Sigma (Rolling)	Float	The scattering value with a rolling average filter
6	Measure ratio	Float	Measure ratio
7	Measure ratio (Kalman)	Float	Measure ratio with a Kalman filter
8	Measure ratio (1 min)	Float	Measure ratio with a 1 minute filter
9	Measure ratio (5 min)	Float	Measure ratio with a 5 minute filter
10	Measure ratio (Rolling)	Float	Measure ratio with a rolling average filter
11	Measure count	Float	Measure count in mHz

Base ID	Description	Data type	Notes
12	Measure count raw	Unsigned	Raw photon count
13	Dark count	Float	Measure count in mHz during dark period
14	Dark count raw	Unsigned	Raw photon count during dark period
15	Shutter count	Float	Measure count in mHz during shutter period
16	Shutter count raw	Unsigned	Raw photon count during shutter period
17	Temperature	Float	Temperature in C at the time of measurement
18	Pressure	Float	Pressure in mBar at the time of measurement
19	ST Correction	Float	ST correction applied to this measurement
20	Calibration slope	Float	As applied to this measurement
21	Calibration offset	Float	As applied to this measurement
22	Rayleigh correction	Float	As applied to this measurement
23	Period	Float	In ms; the measurement period time
24	Wavelength	Float	In nm
25	Angle	Float	In degrees
26	Kalman gain	Float	Current Kalman gain value (unitless)
27	Data set index	Unsigned	A distinguishing index for troubleshooting and diagnosis. Each measurement is incremented by 1, skipping over zero. After 2 billion measurements this will wrap around to 1 again. It is restarted at 1 every time the instrument is rebooted.

Table 46 – Aurora Parameters

#	Description	Notes
0	None	Not a valid parameter
1	Clock	Current time (in Time Stamp format)
1000	USER_CONFIG_DISPLAY	N/A (this value merely denotes the beginning of a new block of parameters)
1001	UNIT_SELECTION_READINGS	0 = Mm-1
1002	UNIT_SELECTION_TEMPERATURE	0 = C 1 = F 2 = K
1003	UNIT_SELECTION_FLOW	0 = SCCM 1 = SLPM
1004	UNIT_SELECTION_PRESSURE	0 = Torr 1 = PSI 2 = Mbar 3 = atm

		4 = Kpa
1005	UNIT_SELECTION_HUMIDITY	0 = %
1006	DECIMAL_SELECTION_READINGS	0..6 = decimal places 7 = scientific notation
1007	DECIMAL_SELECTION_TEMPERATURE	
1008	DECIMAL_SELECTION_FLOW	
1009	DECIMAL_SELECTION_PRESSURE	
1010	DECIMAL_SELECTION_HUMIDITY	
2000	USER_CONFIG_DATALOG	N/A
2001	DATALOG_PARAM_INTERVAL	0 = disabled (no datalogging) 1 = every measurement 2 = 1 second 3 = 2 seconds … 31 = 1 day
2002	DATALOG_PARAM_INTERVAL_SECONDS	The datalogging interval in seconds. Note that Disabled and All are not indistinguishable. 0 = disabled 0 = every measurement 1..8600 = number of seconds between logged records
2003	DATALOG_PARAM_INDEXES	N/A
2004	DATALOG_PARAM_INDEX_1	The parameter # being logged. Note that the Wavelength and Angle indexes control how many actual values are logged for construction parameters. I.e., a 3100 with Wavelength = all and Angle = all will log
2005	DATALOG_PARAM_INDEX_2	
2006	DATALOG_PARAM_INDEX_3	
2007	DATALOG_PARAM_INDEX_4	
2008	DATALOG_PARAM_INDEX_5	
2009	DATALOG_PARAM_INDEX_6	
2010	DATALOG_PARAM_INDEX_7	
2011	DATALOG_PARAM_INDEX_8	
2012	DATALOG_PARAM_INDEX_9	
2013	DATALOG_PARAM_INDEX_10	
2014	DATALOG_PARAM_INDEX_11	
2015	DATALOG_PARAM_INDEX_12	
2016	DATALOG_PARAM_INDEX_13	
2017	DATALOG_PARAM_INDEX_14	
2018	DATALOG_PARAM_INDEX_15	
2019	DATALOG_PARAM_INDEX_16	

2020	DATALOG_PARAM_INDEX_17	
2021	DATALOG_PARAM_INDEX_18	
2022	DATALOG_PARAM_INDEX_19	
2023	DATALOG_PARAM_INDEX_20	
2024	DATALOG_PARAM_INDEX_21	
2025	DATALOG_PARAM_INDEX_22	
2026	DATALOG_PARAM_INDEX_23	
2027	DATALOG_PARAM_INDEX_24	
2028	DATALOG_PARAM_INDEX_25	
2029	DATALOG_PARAM_INDEX_26	
2030	DATALOG_PARAM_INDEX_27	
2031	DATALOG_PARAM_INDEX_28	
2032	DATALOG_PARAM_INDEX_29	
2033	DATALOG_PARAM_INDEX_30	
2034	DATALOG_PARAM_INDEX_31	
2035	DATALOG_PARAM_INDEX_32	
2036	DATALOG_PARAM_WAVELENGTH_INDEXES	N/A
2037	DATALOG_PARAM_WAVELENGTH_INDEX_1	Each logging parameter may represent several logged values. 0 = all currently defined wavelengths 1 = first wavelength only 2 = second wavelength only 3 = third wavelength only
2038	DATALOG_PARAM_WAVELENGTH_INDEX_2	
2039	DATALOG_PARAM_WAVELENGTH_INDEX_3	
2040	DATALOG_PARAM_WAVELENGTH_INDEX_4	
2041	DATALOG_PARAM_WAVELENGTH_INDEX_5	
2042	DATALOG_PARAM_WAVELENGTH_INDEX_6	
2043	DATALOG_PARAM_WAVELENGTH_INDEX_7	
2044	DATALOG_PARAM_WAVELENGTH_INDEX_8	
2045	DATALOG_PARAM_WAVELENGTH_INDEX_9	
2046	DATALOG_PARAM_WAVELENGTH_INDEX_10	
2047	DATALOG_PARAM_WAVELENGTH_INDEX_11	
2048	DATALOG_PARAM_WAVELENGTH_INDEX_12	
2049	DATALOG_PARAM_WAVELENGTH_INDEX_13	
2050	DATALOG_PARAM_WAVELENGTH_INDEX_14	
2051	DATALOG_PARAM_WAVELENGTH_INDEX_15	
2052	DATALOG_PARAM_WAVELENGTH_INDEX_16	
2053	DATALOG_PARAM_WAVELENGTH_INDEX_17	
2054	DATALOG_PARAM_WAVELENGTH_INDEX_18	
2055	DATALOG_PARAM_WAVELENGTH_INDEX_19	

2056	DATALOG_PARAM_WAVELENGTH_INDEX_20	
2057	DATALOG_PARAM_WAVELENGTH_INDEX_21	
2058	DATALOG_PARAM_WAVELENGTH_INDEX_22	
2059	DATALOG_PARAM_WAVELENGTH_INDEX_23	
2060	DATALOG_PARAM_WAVELENGTH_INDEX_24	
2061	DATALOG_PARAM_WAVELENGTH_INDEX_25	
2062	DATALOG_PARAM_WAVELENGTH_INDEX_26	
2063	DATALOG_PARAM_WAVELENGTH_INDEX_27	
2064	DATALOG_PARAM_WAVELENGTH_INDEX_28	
2065	DATALOG_PARAM_WAVELENGTH_INDEX_29	
2066	DATALOG_PARAM_WAVELENGTH_INDEX_30	
2067	DATALOG_PARAM_WAVELENGTH_INDEX_31	
2068	DATALOG_PARAM_WAVELENGTH_INDEX_32	
2069	DATALOG_PARAM_ANGLE_INDEXES	N/A
2070	DATALOG_PARAM_ANGLE_INDEX_1	Each logging parameter may represent several logged values. 0 = all currently defined angles 1 = first angle only 2 = second angle only … 20 = twentieth wavelength only
2071	DATALOG_PARAM_ANGLE_INDEX_2	
2072	DATALOG_PARAM_ANGLE_INDEX_3	
2073	DATALOG_PARAM_ANGLE_INDEX_4	
2074	DATALOG_PARAM_ANGLE_INDEX_5	
2075	DATALOG_PARAM_ANGLE_INDEX_6	
2076	DATALOG_PARAM_ANGLE_INDEX_7	
2077	DATALOG_PARAM_ANGLE_INDEX_8	
2078	DATALOG_PARAM_ANGLE_INDEX_9	
2079	DATALOG_PARAM_ANGLE_INDEX_10	
2080	DATALOG_PARAM_ANGLE_INDEX_11	
2081	DATALOG_PARAM_ANGLE_INDEX_12	
2082	DATALOG_PARAM_ANGLE_INDEX_13	
2083	DATALOG_PARAM_ANGLE_INDEX_14	
2084	DATALOG_PARAM_ANGLE_INDEX_15	
2085	DATALOG_PARAM_ANGLE_INDEX_16	
2086	DATALOG_PARAM_ANGLE_INDEX_17	
2087	DATALOG_PARAM_ANGLE_INDEX_18	
2088	DATALOG_PARAM_ANGLE_INDEX_19	
2089	DATALOG_PARAM_ANGLE_INDEX_20	
2090	DATALOG_PARAM_ANGLE_INDEX_21	
2091	DATALOG_PARAM_ANGLE_INDEX_22	

2092	DATALOG_PARAM_ANGLE_INDEX_23	
2093	DATALOG_PARAM_ANGLE_INDEX_24	
2094	DATALOG_PARAM_ANGLE_INDEX_25	
2095	DATALOG_PARAM_ANGLE_INDEX_26	
2096	DATALOG_PARAM_ANGLE_INDEX_27	
2097	DATALOG_PARAM_ANGLE_INDEX_28	
2098	DATALOG_PARAM_ANGLE_INDEX_29	
2099	DATALOG_PARAM_ANGLE_INDEX_30	
2100	DATALOG_PARAM_ANGLE_INDEX_31	
2101	DATALOG_PARAM_ANGLE_INDEX_32	
2200	DATALOG_MEDIA	The current media for capturing the data log 0 = SD Card 1 = USB Flash drive
2201	DATALOG_LAST_DOWNLOAD	Aurora Legacy Datalogging only
3000	USER_CONFIG_COMMS	N/A
3001	SERIAL_1_ID	Identifying number (signed int)
3002	SERIAL_1_BAUD_RATE	Baud rate (1200,..115200)
3003	SERIAL_1_PROTOCOL	0 = Advanced 1 = Aurora Legacy 2 = Modbus (not supported yet) 3 = Bayern Hessen (not supported yet) 4 = EC9800 (not supported yet)
3004	SERIAL_2_ID	As above
3005	SERIAL_2_BAUD_RATE	As above
3006	SERIAL_2_PROTOCOL	As above
3007	NETWORK_DHCP_MODE	0 = false 1 = true
3008	NETWORK_PROTOCOL	As above
3009	NETWORK_IP_ADDRESS	Unsigned int where bytes 0…3 specify the address
3010	NETWORK_NETMASK	
3011	NETWORK_GATEWAY	
4001	MEASUREMENT_NUMBER_OF_WAVELENGTHS	Wavelengths being measure (1..3)
4002	MEASUREMENT_NUMBER_OF_ANGLES	Angles being measured 1100: 1 3100: 1..2 4100: 1..20
4003	MEASUREMENT_WAVELENGTHS	N/A

4004	MEASUREMENT_WAVELENGTH_1	Wavelength value in nm (450, 525,635)
4005	MEASUREMENT_WAVELENGTH_2	
4006	MEASUREMENT_WAVELENGTH_3	
4007	MEASUREMENT_ANGLES	N/A
4008	MEASUREMENT_ANGLE_1	Angle value in degrees (0..90) The 1100 only reports one angle (always 0) The 3100 reports two angles (always 0 and 90) called forescatter and backscatter The 4100 can report up to 20 angles
4009	MEASUREMENT_ANGLE_2	
4010	MEASUREMENT_ANGLE_3	
4011	MEASUREMENT_ANGLE_4	
4012	MEASUREMENT_ANGLE_5	
4013	MEASUREMENT_ANGLE_6	
4014	MEASUREMENT_ANGLE_7	
4015	MEASUREMENT_ANGLE_8	
4016	MEASUREMENT_ANGLE_9	
4017	MEASUREMENT_ANGLE_10	
4018	MEASUREMENT_ANGLE_11	
4019	MEASUREMENT_ANGLE_12	
4020	MEASUREMENT_ANGLE_13	
4021	MEASUREMENT_ANGLE_14	
4022	MEASUREMENT_ANGLE_15	
4023	MEASUREMENT_ANGLE_16	
4024	MEASUREMENT_ANGLE_17	
4025	MEASUREMENT_ANGLE_18	
4026	MEASUREMENT_ANGLE_19	
4027	MEASUREMENT_ANGLE_20	
4028	MEASUREMENT_DARK_PERIOD	Dark time (ms)
4029	MEASUREMENT_LIGHT_PERIOD	How long the LED is on for a measurement (ms)
4030	MEASUREMENT_DELAY_PERIOD	How long the LED is on before a measurement starts (warm up and stabilization time) (ms)
4031	MEASUREMENT_REFERENCE_AVERAGES	Number of averages in each measurement (1..12)
4032	MEASUREMENT_SCATTERING_CYCLES	Number of complete measurement cycles (all wavelengths and angles) before the reference measurement is repeated (1..90)
4033	CURRENT_WAVELENGTH	The wavelength currently being measured (nm)

4034	CURRENT_ANGLE	The angle currently being measured (degrees)
4035	CURRENT_OPERATION	The operating state of the instrument. These stats flag logged data as part of normal measurement or a calibration state. 0 = Normal monitoring data 1 = Zero calibration data 2 = Span calibration data These states only appear when a calibration state is completed. A single record will be captured with the user-defined parameters and one of the following current operation values. 3 = Zero adjust completed 4 = Zero check completed 5 = Span calibration completed 6 = Span check completed
4036	CURRENT_STATE	The current state of the measurement: 0 = Initializing 1 = Dark period 2 = Reference measurement 3 = Scattering measurements
5001	CURRENT_SAMPLE_TEMPERATURE	K
5002	CURRENT_SAMPLE_PRESSURE	mBar
5003	CURRENT_SAMPLE_RH	%
5004	CURRENT_CHASSIS_TEMPERATURE	K
5005	CURRENT_CHASSIS_PRESSURE	mBar
5006	CURRENT_CHASSIS_RH	%
5007	CURRENT_AMBIENT_TEMPERATURE	K
5008	CURRENT_AMBIENT_PRESSURE	mBar
5009	CURRENT_AMBIENT_RH	%
5010	FLOW	SLPM
6001	ANALOG_INPUT_LED_VOLTAGE	V
6002	ANALOG_INPUT_COOLER_VOLTAGE	V
6003	ANALOG_INPUT_COOLER_TEMPERATURE	V
6004	ANALOG_INPUT_3_3_V_SUPPLY	V
6005	ANALOG_INPUT_5_0_V_SUPPLY	V
6006	ANALOG_INPUT_12_0_V_SUPPLY	V
6007	ANALOG_INPUT_24_0_V_SUPPLY	V

6008	ANALOG_INPUT_FUSE_CURRENT	mA
6009	ANALOG_INPUT_COOLER_CURRENT	mA
6010	ANALOG_INPUT_ANALOG_FLOW	V
6011	ANALOG_INPUT_MFC_FLOW	SLPM
6012	ANALOG_INPUT_AMBIENT_RH	%
6013	ANALOG_INPUT_AMBIENT_TEMP	K
6014	ANALOG_INPUT_SPARE	N/A
6015	ANALOG_INPUT_1	V
6016	ANALOG_INPUT_2	V
6017	ANALOG_INPUT_3	V
6018	ANALOG_INPUT_4	V
7001	DIGITAL_INPUT_1	0..1
7002	DIGITAL_INPUT_2	0..1
7003	DIGITAL_INPUT_3	0..1
7004	DIGITAL_INPUT_4	0..1
7005	DIGITAL_OUTPUT_1	0..1
7006	DIGITAL_OUTPUT_2	0..1
7007	DIGITAL_OUTPUT_3	0..1
7008	DIGITAL_OUTPUT_4	0..1

A.5 Time Stamp Format

All time stamps are in the following bit-wise format. This manages to fit an un-ambiguous date and time into a single 4-byte unsigned integer.

Note the following limits:

Seconds 0..59

Minutes 0..59

Hours 0..23

Date 1..31

Month 1..12

Year 0..63 (implies adding 2000)

3								2								1								0							
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
YEAR						MONTH				DATE						HOUR				MIN						SEC					

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Appendix B. Aurora Protocol

This document contains an explanation of the available commands and their syntax.

Note: The commands are case sensitive and need to be uppercase for them to work correctly.

B.1 Command: ID

Polls the Aurora NE for the instrument type, the current software/firmware version and the unique factory allocated identification number of the Aurora NE.

Syntax:

ID{<Serial ID>}<cr>

Response:

Aurora NE-XXX{<model ID>} v{<firmware version>} ID #{<instrument Serial ID>}<CR><LF>

Example:

Sending:	ID0<CR>
Possible Responce:	Aurora NE-400 v5.0 ID #220838<CR><LF>

Related Commands:

Pressing CONTROL-T also gives the same response.

B.2 Command: ***B

Erases the data log memory.

Note: This command will only work if you have applied the Legacy Datalogging. Activated by pressing the Legacy Datalogging button on the datalog Parameters panel on the Config page.

Syntax:

***B<CR>

Response:

OK<CR><LF>

B.3 Command: ***D

Downloads the new content of the data log. The number of responses will depend on how many entries are in the data log that have not yet been downloaded.

Syntax:

***D<CR>

Response:

Multiple comma separated data entry: Time, Status, Type, scattering values for each wavelength & angle, air temp, cell temp, humidity, and pressure <CR><LF>

Example:

18/6/2022
16:01:00,60,0,2.142656e+01,3.311639e+01,3.764827e+01,1.825488e+01,3.121719e+01,3.300115e+01,1.529951e+01,2.430883e+01,2.693074e+01,1.408008e+01,1.487485e+01,1.997404e+01,2.971700e+02,1.013510e+03,3.926000e+01,2.972700e+02,1.018760e+03,4.552000e+01,3.978850e-02,5.406347e-02,6.493426e-02,3.913681e-02,5.493057e-02,6.418353e-02,4.013822e-02,5.521182e-02,6.538633e-02,4.344866e-02,5.233796e-02,6.638738e-02,9.000056e+01,4.371852e+05,3.804421e+05,4.145539e+

B.4 Command: ***R

Rewinds to the beginning of the data log. The next ***D command will download the entire contents of the data log.

Syntax:

***R<CR>

Response:

OK<CR><LF>

B.5 Command: **PS

Programs the unique factory allocated identification number of the Aurora NE into memory. This ID number can be found on the Identification pane on the Factory child page.

Syntax:

**{<Serial ID>}PS{space}{<instrument serial ID>}<CR>

Response:

OK<CR><LF>

Example:

Sending: **0PS_123456<CR>

Responce: OK<CR><LF> (and sets the instrument serial ID to 123456.)

B.6 Command: **B

Re-Boot test. When initiated the Watchdog timer will be activated and cause the Aurora 4000 microprocessor to re-boot. The same as pressing the reset button on the microprocessor board.

Syntax:

**{<Serial ID>}B<CR>

Response:

OK<CR><LF>

Example:

Sending: **0B<CR>

Response: Will re-boot the Aurora NE

B.7 Command: VI

Reads up to 100 different parameters from the Aurora NE microprocessor. Ideal for data logging devices which can poll the instrument for its data.

Syntax:

VI{<Serial ID>}{<voltage input parameter number>}<CR>

Response:

{<sign>}{<parameter value>}<CR><LF>

Arguments:

<sign> = <space> if positive, <-> if negative. (if the output is an ASCII character, then there is no <sign>.

<parameter value> = a value which can be either an ASCII character string, or a decimal number to six decimal places.

<voltage input parameter number> = one of the following from Table 47 – Table 47:

Table 47 – VI voltage input numbers

Voltage input number	Description
00	Current Monitoring State (Major.Minor) 2 decimal places for minor.
03	Scat coefficients. Mm-1 in current reporting preference
04	Dark count (moving average).
05	Dark count last reading.
12	
13	
14	
16	Sample relative humidity in current reporting preference.
18	Sample temperature in current reporting preference.
19	Sample pressure in current reporting preference.
20	Chassis relative humidity in current reporting preference.
21	Chassis temperature in current reporting preference.
22	Chassis pressure in current reporting preference.
28	Wavelengths
32	Backscatters
37	Backscatters Measurement counts in current reporting preference
40	Backscatter Measurement Ratio in current reporting preference
41	Flow in current reporting preference
64	Date format setting
65	Temp unit setting
66	Pressure unit setting
68	Major state
68	Minor state
71	Span/zero measure mode status. 000 = measure, 016 = span, 032 = zero.
80	Clock date in current reporting preference
81	Clock time in hh:mm:ss format
84	Kalman gain (first angle only)
90	Digital output status – PortD
98	Number of angles, angle 1, angle 2, etc.
99	Real time parameters obtained as one comma delimited string.

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acoem

1492 Ferntree Gully Road,

Knoxfield, Victoria,

Australia 3180

Phone: +61 (0)3 9730 7800

Email: info.au@acoem.com

Support: support@ecotech.com

www.ecotech.com